Missouri Department
of Natural Resources

Biological Assessment and Stressor Study

North Fork of the Spring River
Barton, Dade, and Jasper Counties

2006 - 2007

Prepared for:

Missouri Department of Natural Resources
Division of Environmental Quality
Water Protection Program
Water Pollution Control Branch

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Table of Contents

Page

Page

TABLES

Page

FIGURES

ATTACHMENTS

1.0 Introduction

At the request of the Missouri Department of Natural Resources (**MDNR**), Water Protection Program (**WPP**), Water Pollution Control Branch (**WPCB**), the Environmental Services Program (**ESP**), Water Quality Monitoring Section (**WQMS**) conducted a macroinvertebrate bioassessment and stressor study of the North Fork of the Spring River in Barton, Dade, and Jasper Counties. The study was performed on a 51.5 mile segment of the North Fork of the Spring River (**NFSR**) that flows from just upstream of Golden City to the approximate confluence of Dry Fork Creek located southeast of Jasper. Macroinvertebrates were collected at ten stations during the fall 2006 sampling season and nine stations during the spring 2007 sampling season. Benthic sediment, channel morphology measurements, and discrete water quality samples were collected at all sampling stations during the summer and fall of 2006. Dissolved oxygen/water temperature dataloggers were also deployed during the summer of 2006 at four stations to determine dissolved oxygen levels. Fish community samples and habitat measurements were collected by the Missouri Department of Conservation (**MDC**), Resource Assessment and Monitoring Program (**RAM**) at three stations within and one station just downstream of the NFSR segment during the summer of 2006. The MDC data is used with data collected by MDNR to assess the 303(d) listed segment of the NFSR.

1.1 Study Area/Justification

North Fork of the Spring River originates in western Dade County near the town of Golden City and is located within the Ozark/Neosho Ecological Drainage Unit (**EDU**). North Fork of the Spring River is listed in the Missouri Water Quality Standards (MDNR 2005a) as a class "C" stream for 51.5 miles (Waterbody ID #3188) and continues as a class "P" stream for 14.5 miles to its confluence with the Spring River in Jasper County. Designated uses for NFSR are "warm water aquatic life protection, human health/fish consumption and livestock and wildlife watering." The 51.5 mile, class C segment of the NFSR was placed on the 2002 303(d) list for elevated levels of sediment.

North Fork of the Spring River is a tributary of the Spring River system. This system flows through a southwestern Missouri geographical area that is transitional between ecoregions, having terrestrial features of both the Ozark and Central Plains Ecoregions (Chapman et al. 2002). A large portion of North Fork of the Spring River has a transitional nature and is characterized by long pools with short, rock and gravel riffles with surface geology of shale, sandstone, and limestone (Pflieger, 1989). Upstream of the town of Lamar the stream is transitional. Just downstream of the town of Lamar it changes to a glide/pool plains type stream, where it tends to have no riffles, bottom substrate made up of fine particle sizes, and abundant large woody debris. Just upstream of the town of Jasper the stream then changes back to a transitional stream where it has a wider channel, rock outcroppings, defined riffles, and more abundant coarse substrate.

A unique aspect to this study stems from the Ozark/Neosho EDU having no glide-pool reference streams. In fact, there are very few glide/pool streams in the Ozark/Neosho EDU and most are listed as impaired. To assess the NFSR support of aquatic life protection we utilized biological criteria calculated from riffle/pool reference streams in a transitional area of the Ozark/Osage

EDU and glide/pool reference streams in the Central Plains/Osage/South Grand EDU. Detrended Correspondence Analysis (**DCA**) was used to analyze the similarity of the macroinvertebrate communities of the NFSR sampling stations; Little Drywood Creek (**LDC**), a reference stream in the CentralPlains/Osage/South Grand EDU; and Horse and Cedar Creeks, two reference streams in a transitional area of the Ozark/Osage EDU. Macroinvertebrate communities from the NFSR test stations more similar to the community from the Ozark/Osage EDU were then compared to riffle/pool biological criteria for that EDU. Macroinvertebrate communities from the NFSR test stations more similar to the community from the Central Plains/Osage/South Grand EDU were compared to glide/pool biological criteria for that EDU.

Previous biological assessment studies determined a probable impairment to the NFSR macroinvertebrate community (MDNR 2004a and MDNR 2004b). The habitat assessments conducted on the lower NFSR in the fall of 2004 showed that benthic sediment could be a stressor in the glide/pool section that starts at Lamar and ends approximately at the Highway 126 Bridge crossing (Figure 1). The percentage of stream bottom covered by fine sediment was greater than 60 percent at three sampling stations. A Total Maximum Daily Load (**TMDL**) for the NFSR was completed by the United Stated Environmental Protection Agency, Region 7 (U.S. EPA 2006). The TMDL found that turbidity converted to total suspended solids (**TSS**) from water samples collected on the NFSR was elevated compared to TSS reference condition for the Ozark/Neosho EDU. Reference condition for the TMDL was determined by calculating the 25th percentile of all available data for the Ozark/Neosho EDU. Water quality data from the previous biological assessment studies and a wasteload allocation study on the Lamar WWTF (MDNR 2005b) showed that the NFSR tends to have low dissolved oxygen levels during low flow periods in the summer and early fall. These results indicate that sediment and/or low dissolved oxygen could be the stressors to the macroinvertebrate community.

1.2 Purpose

Determine if the macroinvertebrate community in the NFSR is still impaired. If macroinvertebrate community is impaired, a second objective is to determine what stressors are causing the impairment.

1.3 Tasks

1) Collect macroinvertebrate community data in the NFSR and use DCA to determine if the community is more similar to LDC, a reference stream in the Central Plains/Osage/South Grand EDU or to Cedar Creek and Horse Creek, two reference streams in a transitional area of the Ozark/Osage EDU. This will determine what biological criteria to use in determining impairment of the NFSR test stations.

2) Conduct a biological assessment of the macroinvertebrate community in the NFSR at ten test stations.

3) Measure the levels of the benthic sediment at the NFSR test stations, a biological criteria reference stream in the Central Plains/Osage/South Grand EDU, and two biological criteria reference streams in a transitional area of the Ozark/Osage EDU. This will determine if there

is a statistical difference between the sediment levels at the NFSR test stations and the reference streams by using one way Analysis of Variance or Kruskall-Wallis ANOVA and Student-Newman-Keuls multiple comparison test.

4) Collect stream width and depth measurements to determine possible habitat alterations caused by past stream channelization.

5) Deploy dataloggers during the summer months at some NFSR test stations and Horse Creek, a biological criteria reference stream, to determine if dissolved oxygen is consistently low and try to determine the temporal duration of the low dissolved oxygen levels. Compare the dissolved oxygen data collected by MDNR to data collected by the Environmental Resources Coalition (**ERC**) at LDC and Cedar Creek.

6) Conduct a water quality assessment at the sampling stations to determine potential water quality impacts.

1.4 Null Hypotheses

1) Benthic sediment, stream channel measurements, and dissolved oxygen of the NFSR test stations will not differ from the two biological criteria reference streams in a transitional area of the Ozark/Osage EDU and LDC, a biological criteria reference stream in the Central Plains/Osage/South Grand EDU.

2) Benthic sediment, stream channel measurements, and dissolved oxygen will not differ between longitudinally separate reaches of the NFSR.

3) The macroinvertebrate community in NFSR will not differ from the two biological reference streams in a transitional area of the Ozark/Osage Ecological Drainage Unit and/or LDC, a biological criteria reference stream in the Central Plains/Osage/South Grand EDU.

4) The macroinvertebrate community will not differ between longitudinally separate reaches of the NFSR.

2.0 Methods

Carl Wakefield, Mike Irwin, Randy Sarver, Dave Michaelson, and Brandy Bergthold of the Missouri Department of Natural Resources, Field Services Division, Environmental Services Program, Water Quality Monitoring Section conducted this study.

2.1 Study Timing

Macroinvertebrate and discrete water quality samples were collected for one fall and one spring season. Fall sampling was conducted from September 25 to October 4, 2006 and spring sampling was conducted on March 19-20, 2007 and April 3-5, 2007. Dissolved oxygen/water temperature dataloggers were deployed at NFSR station #6 from July 31 to August 3, 2006; at NFSR stations #1 and #3 from August 7-10, 2006; and at NFSR station #9 and a reference station on Horse Creek from August 28 to September 1, 2006. Benthic sediment and stream channel measurements were collected at the NFSR test stations and biological criteria reference stations on August 28 to September 1, 2006, September 18, 2006, and September 25-26, 2006.

2.2 Station Descriptions

Ten test stations and four biological reference stations were sampled for this study. See Figure 1 for a map of the locations of the test stations. NFSR test station #4 and LDC #2 were sampled only during the fall 2006 sampling season. NFSR #4 was not sampled during the spring 2007 sampling season because of high water levels. LDC #2 was not sampled during the spring 2007 sampling season because of the extreme low water levels during the fall 2006 sampling season. Fish, habitat measurements, and water quality were collected at four stations within or just downstream of the segment on the NFSR during the summer of 2006 (Figure 1).

2.2.1 MDNR Sampling Stations

NFSR #1: Legal description was SE ¼, sec. 29, T. 30 N., R. 31 W. Geographic coordinates were latitude 37.313939 N. and longitude -94.362890 W. Station #1 was located upstream of Redbud Road in Jasper County. The station had better defined riffle/run segments with a much wider channel and shallower water depths than the other stations. There were rock outcroppings that lined part of the banks and coarse substrate was much more common in all habitats than at the other sampling stations.

NFSR #2: Legal description was SW ¼, sec. 11, T. 30 N., R. 31 W. Geographic coordinates were latitude 37.356690 N. and longitude -94.315090 W. Station #2 was located upstream of SW 100th Road in Barton County. The station was transitional in nature in that it had some deep pools with a lot of woody debris and shallow run segments that had rock outcroppings along the bank. It was at this point that the stream was changing from a glide/pool stream to a riffle/pool stream.

NFSR #3: Legal description was SW ¼, sec. 26, T. 31 N., R. 31 W. Geographic coordinates were latitude 37.399540 N. and longitude -94.309820 W. Station #3 was located upstream of Highway 126 in Barton County. This was a glide/pool station that had a narrow channel with a high abundance of woody debris. Water depth was high in some of the pool habitat and the stream channel was well shaded for much of the sample reach.

NFSR #4: Legal description was SE ¼, sec. 14, T. 31 N., R. 31 W. Geographic coordinates were latitude 37.427719 N. and longitude -94.300911 W. Station #4 was located downstream of Highway 71 in Barton County. This station was similar in character to station #3, but generally had greater water depths. Water at this station was green from planktonic algae during late July

and early August 2006, but was no longer green when sediment and channel measurement were collected on August 31, 2006.

NFSR #5: Legal description was SE ¼, sec. 1, T. 31 N., R. 31 W. Geographic coordinates were latitude 37.456960 N. and longitude -94.281780 W. Station #5 was located upstream of SE 30th Road in Barton County. This station was a glide/pool station that was similar to stations #3 and #4, but had more benthic sediment and less riparian shading. Water at this station was green like station #4 in early August of 2006.

NFSR #6: Legal description was NW ¼, sec. 24, T. 32 N., R. 31 W. Geographic coordinates were latitude 37.508148 N. and longitude -94.288228 W. Station #6 was located upstream of NE 5th Road in Barton County. This was a transitional station that had short riffle/run segments with very fine coarse substrate and pool habitat with some woody debris. The station had a narrow channel that pooled up substantially at the end of August 2006 when benthic sediment was collected.

NFSR #7: Legal description was NE ¼, sec. 22, T. 32 N., R. 30 W. Geographic coordinates were latitude 37.508850 N. and longitude -94.205973 W. Station #7 was located downstream of NE 50th Road in Barton County. This station had the characteristics of a riffle/pool stream with well defined riffle/run segments and a high abundance of coarse substrate covering the stream bottom. The riffle/run segments of the stream were dry during the summer and fall of 2006. This station was downstream of a low water bridge crossing that was acting like a dam since it was holding back water upstream of the crossing. The NFSR upstream of the crossing was pooled for many miles.

NFSR #8: Legal description was NE ¼, sec. 31, T. 32 N., R. 29 W. Geographic coordinates were latitude 37.482554 N. and longitude -94.157254 W. Station #8 was located upstream of SE 10th Road in Barton County. This station had two well defined riffle/run segments at the downstream end of the sampling reach that were dry during the summer and fall of 2006. The rest of the station was made up of a very long, deep, and wide pool that made up at least 2/3 of the sampling reach.

NFSR #9: Legal description was NE ¼, sec. 9, T. 31 N., R. 29 W. Geographic coordinates were latitude 37.452007 N. and longitude -94.123589 W. Station #9 was located upstream of SE 30th Road in Barton County. The station was very similar to station #8 except that it only had one well defined riffle/run segment and it had more short pools instead of a long pool like that present at station #8. This station was pooled during the summer and fall of 2006.

NFSR #10: Legal description was SW ¼, sec. 36, T. 31 N., R. 29 W. Geographic coordinates were latitude 37.378500 N. and longitude -94.077639 W. Station #10 was located upstream of SE 79th Road in Dade County. The stream at this station was much smaller in size than stations #8 and #9. It had two well defined riffle/run segments that were dried up during the summer and fall of 2006. The pools at this station were fairly deep at some locations, but were not as wide or long as at stations #8 and #9.

Cedar Creek #1: Legal description was NE ¼, sec. 8, T. 33 N., R. 27 W. Geographic coordinates were latitude 37.910861 N. and longitude -93.622944 W. This station was located downstream of Highway B in Cedar County. Water levels at this station were very low during the summer and fall of 2006. The stream was pooled during this time period and filamentous algae were very abundant in the pools. Cows had access to the creek, which was impacting the condition of the stream banks and possibly causing eutrophication of the water. This station was Ozark-like, having well defined riffle/run segments made up of coarse substrates along with some bedrock.

Horse Creek #1: Legal description was SW ¼, sec. 3, T. 34 N., R. 28 W. Geographic coordinates were latitude 37.72308 N. and longitude -93.99561 W. This station was located downstream of County Road 425 in Cedar County. The water levels at this station were extremely low during the summer and fall of 2006. There were large reaches of stream that were completely dry from August thru early October 2006. This stream station was transitional in nature, having characteristics of both Ozark and plains streams. The riffle/run segments were made up of large substrate with a high abundance of cobble and flat boulder sized rocks. The stream channel was more incised with taller banks than most Ozark streams.

LDC #1: Legal description was SE ¼, sec. 30, T. 35 N., R. 31 W. Geographic coordinates were latitude 37.785800 N. and longitude -94.390080 W. This station was located upstream of County Road 515 E in Vernon County. This glide/pool station was made up entirely of pool habitat except for a small turbulent segment located at the downstream edge of the sampling reach. The turbulent segment was formed from a bedrock outcropping. The station had a smaller channel width and shallower water depths than most of the NFSR test stations. The station had an abundant amount of woody debris and a low flow during the summer and fall of 2006.

LDC #2: Legal description was SE ¼, sec. 36, T. 34 N., R. 32 W. Geographic coordinates were latitude 37.65240 N. and longitude -94.38638 W. This station was located within the Bushwhacker Conservation Area downstream of NW 100th Road in Vernon County. This station was smaller than LDC #1 and was pooled during the summer and fall of 2006. No rootmat (RM) habitat was available to sample during the fall 2006 macroinvertebrate sampling season.

2.2.2 MDC Sampling Stations

NFSR Site Number 207-1327: Legal description was NW ¼, sec. 14, T. 31 N., R. 29 W. Geographic coordinates were latitude 37.4344 N. and longitude -94.0975 W. This station was located at the Highway 160 crossing north of the town of Golden City in Barton County. It was approximately 1.5 to 2 miles upstream of MDNR station NFSR #9.

NFSR Site Number 207-1171: Legal description was SE ¼, sec. 30, T. 32 N., R. 29 W. Geographic coordinates were latitude 37.4846 N. and longitude -94.1596 W. This station was located downstream of SE 10th Road in Barton County. The station was located at the same road crossing as MDNR station NFSR #8, but was downstream of the road crossing instead of upstream of the road crossing.

NFSR Site Number 207-1601: Legal description was NW ¼, sec. 14, T. 30 N., R. 31 W. Geographic coordinates were latitude 37.3543 N. and longitude -94.3127 W. This station was located downstream of SW 100th Road in Jasper County. The station was located at the same road crossing as MDNR station NFSR #2, but was downstream of the road crossing instead of upstream of the road crossing.

NFSR Site Number 207-1828: Legal description was NE ¼, sec. 1, T. 29 N., R. 32 W. Geographic coordinates were latitude 37.2932 N. and longitude -94.3686 W. This station was located downstream of Highway M and the confluence of Dry Fork Creek in Jasper County. The station was about 1.5 to 2 miles downstream of MDNR station NFSR #1.

2.3 Aquatic Ecological Classification

The aquatic ecological classification system developed by the Missouri Resource Assessment Partnership (**MoRAP**) divides the aquatic resources of Missouri into distinct regions. It has seven levels of hierarchical classification (Sowa et al., 2004), which in descending order are: zone, subzone, region, aquatic subregions, EDU, Aquatic Ecological Systems (**AES**), and Valley Segment types (**VST**). The levels of classification are based on biology, zoogeography, taxonomic composition, geology, soils, and groundwater connection. Some classification levels of the hierarchical system use geology and soils and other levels use biology and taxonomic composition of aquatic communities. Ecological Drainage Units and AES are the two hierarchical levels of the classification that are utilized in this study.

Reference is also made in this study to terrestrial based ecoregions (Chapman et al. 2002). Ecoregion boundaries are shown along with Ecological Drainage Unit boundaries in Figure 1. The terrestrial ecoregion boundaries are used as additional information to demonstrate the complex ecological nature of the NFSR system. The NFSR system is also an excellent example of a Missouri aquatic ecological area where a drainage boundary takes hierarchical precedence over terrestrial boundaries. Streams that are in this transitional area and drain to different EDUs have significant migration and evolutionary barriers to the aquatic biological community and cannot be expected to be comparable. The headwaters of the Spring River are separated from the headwaters of the Osage River by hundreds of river miles, yet only a few miles by land in some locations. For this reason it is necessary to use an aquatic based ecological classification system when performing stream biological assessments.

2.3.1 Ecological Drainage Units

The EDU is level five of the classification hierarchy and is based on geographical variation of the taxonomic composition of the level four subregions. An EDU is a region in which aquatic biological communities and habitat conditions can be expected to be similar. A map of the Ozark/Neosho EDU is inset in Figure 1. All of the NFSR sampling stations are within this EDU.

Table 2 compares the land cover percentages from the Ozark/Neosho EDU and the 14-digit Hydrologic Units (**HU)**, which contain the NFSR test stations, the two biocriteria reference streams from a transitional area of the Ozark/Osage EDU, and LDC, a biocriteria reference stream in the Central Plains/Osage/South Grand EDU. Land cover data were derived from Thematic Mapper satellite images collected from 2000 to 2004 and interpreted by MoRAP. Cropland was the dominant percent land use of the NFSR watershed and was higher than the values for the entire Ozark/Neosho EDU and the 14-digit HU containing the biological criteria

reference stations. Grassland and forest were generally lower than the values for the entire Ozark/Neosho EDU and the biological criteria reference stations. The only exception was the HU that contained NFSR test stations #8 and #9. This HU had a similar percentage forest cover to the HU that contained the LDC reference stations, but much lower than the HU containing the other biological criteria reference stations and the entire Ozark/Neosho EDU (Table 1).

2.3.2 Aquatic Ecological Systems

The AES is level six of the classification hierarchy and is based on geology, soils, landform, and groundwater influence. AES with similar characteristics are grouped into AES types. Aquatic Ecological Systems types can appear to cross over EDU boundaries in transitional areas that have similar geology and soils. However, the drainage boundaries of the EDU are enforced in the hierarchical classification system.

The South Deepwater Creek AES type contains the watersheds of the NFSR, in the Ozark/Neosho EDU, and biological criteria reference stream LDC, in the Central Plains/Osage/South Grand EDU (Figure 2). The South Deepwater Creek AES type generally has local relief less than 100 feet and has soil surface textures made of primarily silt loams with very slow to moderate infiltration rates (Sowa and Diamond, 2006). Sandstone and shale are the dominant deposits in this AES type and these deposits impede downward water movement. Most of the water making up stream discharge in this AES type comes from surface flow since springs are not very abundant. The streams in this AES type have very low flows for even the larger watersheds because of the low infiltration rates and the lack of springs.

The Clear Creek AES type contains the watershed of Horse Creek, which is in the Ozark/Osage EDU (Figure 2). Local relief ranges from nearly zero to 200 feet, but most areas are between 50 to 100 feet. Bedrock geology is primarily Pennsylvanian limestone and the soil surface textures are made of silty loams and loams with moderate to sometimes very slow infiltration rates. Streams in the Clear Creek AES type have their highest flows in the spring and occasionally go nearly dry during dry periods in the summer and fall. Springs are not common, but groundwater is abundant and often saline.

The Moniteau Creek AES type contains the watersheds of Cedar Creek, in the Ozark/Osage EDU, and lower Spring River, in the Ozark/Neosho EDU (Figure 2). Local relief ranges from nearly zero to 200 feet. Bedrock consists primarily of Mississippian and Pennsylvanian cherty limestone. Karst features including sinkholes are scattered in this AES type. Surface soil textures are primarily loams or silt loams with slow to moderate infiltration rates and groundwater is abundant in the Moniteau Creek AES type.

Figure 1
Map of North Fork of the Spring River (NFSR) and Sampling Stations

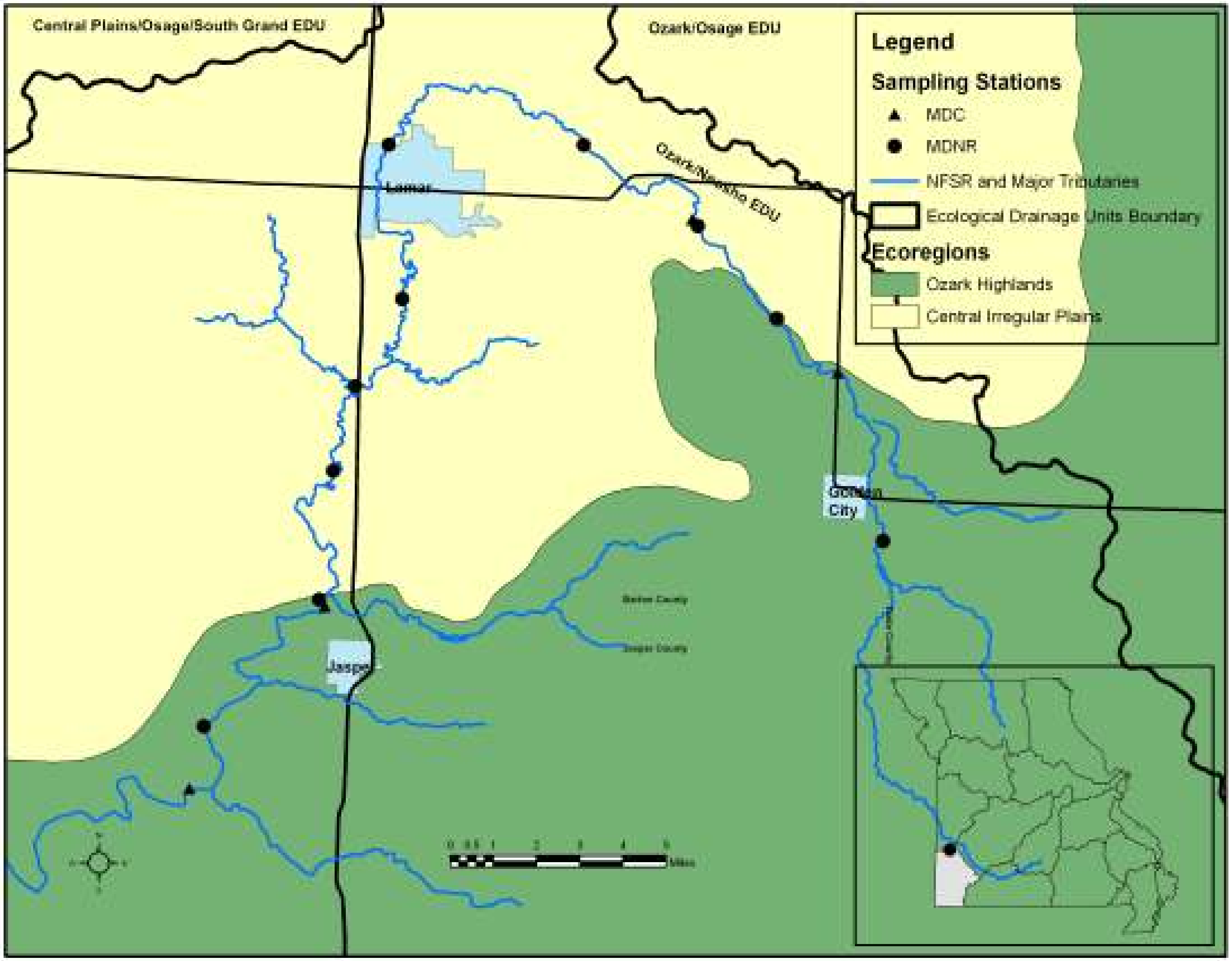


Figure 2
Aquatic Ecological Systems (AES) Types for Cedar Creek, Horse Creek, Little Drywood Creek, North Fork Spring River, and the Lower Spring River

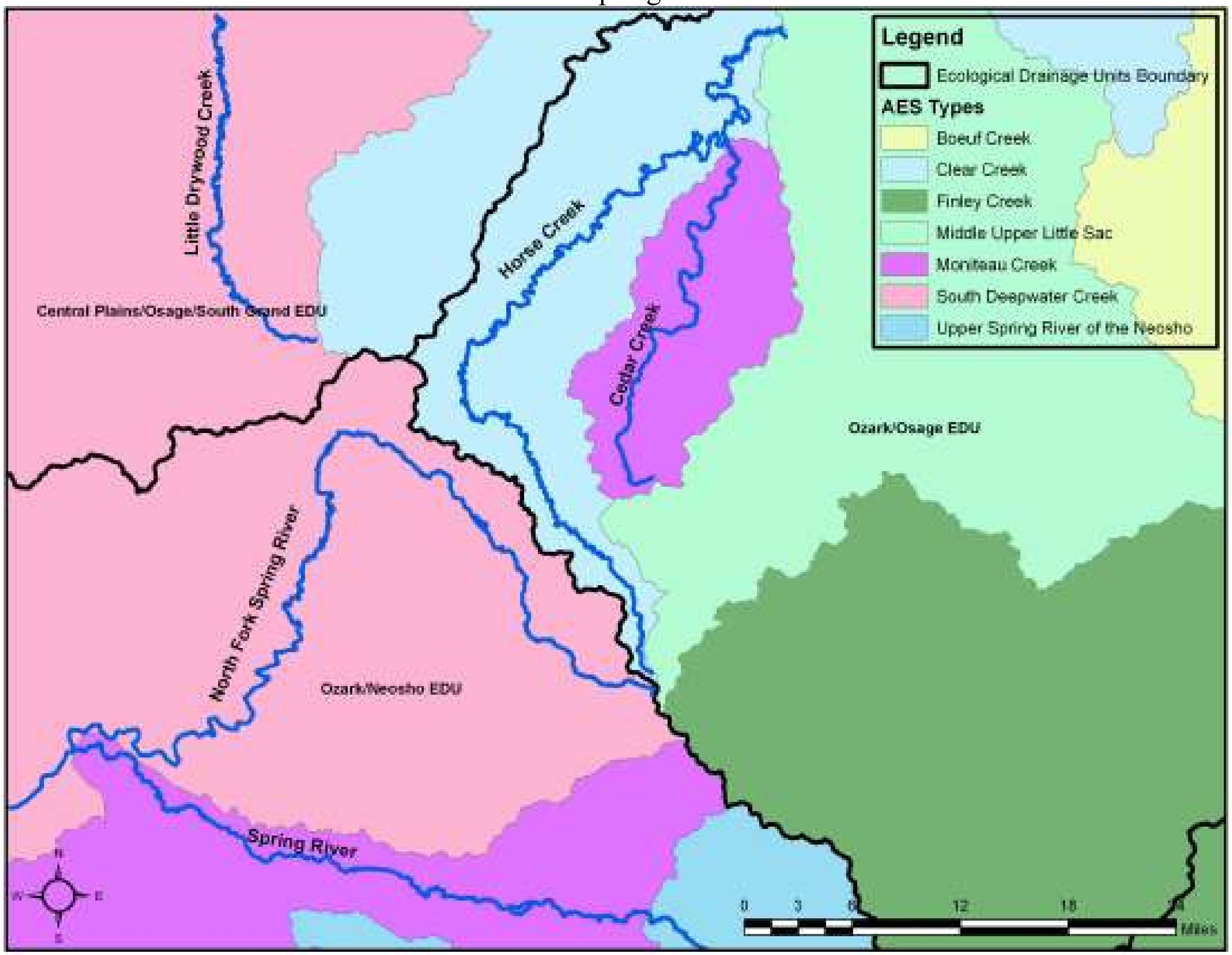


Table 1
Percent Land Cover

Land Cover	14-digit Hydrological Unit (HU)	Urban	Crops	Grassland	Forest	Wetland
Ozark/Neosho EDU	Multiple Hydrological Units	4	15	52	25	0
NFSR #1	11070207080003	3	35	50	7	2
NFSR #2-#4	11070207070004	2	53	32	6	3
NFSR #5-#7	11070207060004	7	46	31	5	6
NFSR #8-#9	11070207060003	1	38	42	12	4
NFSR #10	11070207060002	2	60	31	4	1
Cedar Creek #1	10290106090006	0	3	65	28	0
Horse Creek #1	10290106090005	0	4	56	33	4
L. Drywood Creek #1	10290104060002	2	22	54	12	7
L. Drywood Creek #2	10290104060001	1	27	50	13	6

2.4 Biological Assessment

Biological assessment consists of macroinvertebrate collection and physicochemical sampling for two sample periods.

2.4.1 Macroinvertebrate Collection and Analysis

A standardized macroinvertebrate sample collection and analysis procedure was followed as described in the Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure

(**SMSBPP**) (2003a). The SMSBPP has separate sampling procedures for riffle/pool (**RP**) and glide/pool (**GP**) stream types. The three standard habitats collected at RP stream types are: flowing water over coarse substrate (**CS**); depositional substrate in non-flowing water (**NF**); and rootmat (**RM**). The three standard habitats collected at GP stream types are: NF, large woody debris (**SG**), and RM. At NFSR sampling stations that were in transitional stream reaches CS, NF, SG, and RM were collected so that both RP and GP metrics could be calculated. Sampling these four habitats is referred to in this document as a transitional stream type.

Macroinvertebrate data were analyzed using three methods. The first analysis used DCA, an ordination method, to determine if the macroinvertebrate community at the NFSR test stations were more similar to data collected at Little Drywood Creek, a glide/pool biological criteria reference stream in the Central Plains/Osage/South Grand EDU or more similar to data collected at Horse and Cedar Creeks, riffle/pool biological criteria reference streams in a transitional area of the Ozark/Osage EDU. This determined what biological criteria to use in assessing the NFSR test stations.

The second analysis of the biological data was an evaluation of macroinvertebrate community composition by percent composition of different macroinvertebrate groups. Comparisons of the NFSR macroinvertebrate community and biological criteria reference stations were made.

The third analysis calculated the Missouri Stream Condition Index (**MSCI**) for each macroinvertebrate sample using the four primary biological metrics found in the SMSBPP. The four primary metrics in the SMSBPP are: 1) Taxa Richness (**TR**); 2) Ephemeroptera/Plecoptera/Trichoptera Taxa (**EPTT**); 3) Biotic Index (**BI**); and 4) Shannon Diversity Index (**SDI**). The metric evaluations were done by comparing the NFSR sample stations on a seasonal basis to the biological criteria calculated from Cedar and Horse creeks, a transitional area of the Ozark/Osage EDU and/or the biological criteria for the Great Plains/Osage/South Grand EDU. Detrended Correspondence Analysis determines which biological criteria will be used. Test stations that ordinate closer to Little Drywood Creek data will be assessed using biological criteria for the Great Plains/Osage/South Grand EDU while stations that ordinate closer to the Cedar and Horse creeks data will be assessed using the Ozark/Osage EDU biological criteria calculated from the transitional area.

2.5 Physicochemical Water Sample Collection and Analysis

Physicochemical grab samples collected during the fall 2006 and spring 2007 sampling seasons were analyzed for the following variables: turbidity, ammonia-N, nitrate/nitrite-N, total nitrogen, chloride, and total phosphorus. Temperature, pH, conductivity, dissolved oxygen, and discharge were measured in the field. All grab samples were collected per MDNR-ESP-001: Required/Recommended Containers, Volumes, Preservatives, Holding Times, and Special Sampling Considerations (MDNR 2003b), were kept on ice until they were delivered to the ESP laboratory, and were recorded on a chain-of-custody per MDNR-ESP-002 (MDNR 2005c).

Results of water quality analyses were compared to Water Quality Standards (MDNR 2005a). NFSR is classified as a class "C" stream and a general warm-water fishery (**GWWF**) for the

study reach. Waters designated as GWWF "allow the maintenance of a wide variety of warm-water biota, including naturally reproducing recreationally important fish species". Criteria for the designated use of "Protection of Aquatic Life" are applicable as well as the rate of exposure, such as chronic or acute. This was important to determine limits for pollutants that could be tolerated by aquatic life over a period of time.

Results are shown from discrete physicochemical collections and analyses during each of the macroinvertebrate sampling periods in 2006 and 2007 (Tables 12 and 13). Data loggers were used to collect dissolved oxygen and water temperature every 15 minutes at four NFSR test stations and at Horse Creek #1. These results are shown in Figures 4 thru 8 and Appendix D.

2.5.1 Discharge

Stream flow was measured using a Marsh-McBirney Flow Meter at each station and discharge was calculated as cubic feet per second (**cfs**). Methodology was in accordance with the standard operating procedure MDNR-ESP-113, <u>Flow Measurement in Open Channels</u> (MDNR 2003c).

2.6 Benthic Sediment Sampling

Benthic sediment was sampled using a draft protocol as described in Attachment A, Appendix A of the NFSR stressor study plan. This method involved using a WQMS designed benthic plunger sampler to collect sediment at 10 evenly spaced transects at each of the ten NFSR test stations and the four biological criteria reference stations. The amount of sediment collected (cm^3) was measured using settling tubes. Sediment estimates for silt, sand, and total sediment for each transect were determined. One-way Analysis of Variance (**ANOVA**), Kruskal-Wallis ANOVA on Ranks, and Student-Newman-Keuls Multiple Comparison tests were used to determine if the amount of sediment was significantly different between the sampling stations.

2.7 Sinuosity

Sinuosity was used as an indicator of historic channelization. Using the National Hydrography Dataset (**NHD**) and Arcmap® software, the sampling stations were placed in the approximate middle of a two-mile stream segment and sinuosity was measured by calculating the ratio of the stream length distance divided by the straight-line distance. Values close to 1.0 are very straight stream reaches, which indicate potential channelization.

2.8 Channel Measurements

The lack of instream habitat can be observed in many channelized streams in Missouri. Channelized streams that are wide and shallow tend to have less ability to retain pools and woody debris (Haithcoat et al. 2003). At each sampling station, a series of 10 bank-to-bank transects were established. Each transect was equally spaced within the sampling reach, which is 20x the average width. Measurements taken at each transect included lower bank width, wetted width, and water depth at ¼, ½, and ¾ of the distance across the wetted width. To document critical habitat conditions, measurements were collected during the summer low flow period at the same time that the benthic sediment was collected.

2.9 Data Analysis and Quality Control

Areas of data analyses important to this study include biological community, physicochemical water chemistry, benthic sediment quantities, stream sinuosity measurements, and stream channel measurements.

Detrended Correspondence Analysis was used to ordinate macroinvertebrate samples to determine what biological criteria will be used. Biological impairment will be determined by calculating the MSCI.

One-way Analysis of Variance, Kruskal-Wallis ANOVA on Ranks, and Student-Newman-Keuls Multiple Comparison tests were used to determine if the amount of benthic sediment was significantly different between sampling stations. A one-way Analysis of Variance or Kruskal-Wallis ANOVA on Ranks was performed to find possible differences in channel metrics calculated from the channel measurements between sampling stations.

The physicochemical data were examined by variable to identify stations that had violations of the Missouri Water Quality Standards (MDNR 2005a). Sampling stations that had values that were higher or lower than the water quality standards will be discussed with possible influences being identified.

Quality control was used as stated in the various MDNR Project Procedures and Standard Operating Procedures. Duplicate samples at sample station #4 during the fall 2006 sampling season and station #9 in the spring 2007 sampling season were collected and analyzed for macroinvertebrate and physicochemical parameters. A random number of processed macroinvertebrate collections were rechecked for missed specimens.

3.0 Results

3.1 Macroinvertebrate Biological Assessment

3.1.1 Detrended Correspondence Analysis

Detrended Correspondence Analysis was conducted to determine if the macroinvertebrate community at the NFSR test stations were more similar to the community at LDC, a biological criteria reference stream in the Central Plains/Osage/South Grand EDU or more similar to the community at Horse and Cedar creeks, biological criteria reference streams in a transitional area of the Ozark/Osage EDU (Figure 3 and Appendix B). North Fork of the Spring River #1 was sampled as a transitional stream type, NFSR #2-#5 were sampled as GP stream types, NFSR #6-#10 were sampled as transitional stream types, Cedar and Horse creeks were sampled as RP stream types, and LDC was sampled as a GP stream type. Transitional stream types include both RP and GP stream type community data for ordination.

Axis 1 of the DCA for the fall sampling season accounted for most of the variation, having an eigen value of 0.46 and axis 2 an eigen value of 0.19. Axis 1 of the DCA during the spring

sampling season did not account for as much of the variation as the fall sampling season with eigen values of 0.31 for axis 1 and 0.23 for axis 2.

The results of the ordination for both sampling seasons showed that the macroinvertebrate data from the transitional stream types were similar to each other at the NFSR test stations, except test station #1. The ordination for both sampling seasons also showed that the macroinvertebrate communities at NFSR test stations #2-#10 were more similar to most of the samples collected at LDC than samples collected at Cedar and Horse creeks. The ordination results for NFSR test station #1 showed that it had a macroinvertebrate community that was different from the other test stations and it tended to ordinate closer to the RP samples collected at Cedar and Horse creeks. It was determined from these results that NFSR #1 would be assessed as an RP stream type using biological criteria collected at Cedar and Horse creeks and the rest of the test stations would be assessed as GP stream types using biological criteria from the Central Plains/Osage/South Grand EDU.

Next, a simplified second ordination was performed (Figure 4 and Appendix C). This ordination used only RP data for NFSR #1, Cedar Creek, and Horse Creek and GP data at the other NFSR stations and LDC. Spearman rank correlation between DCA axis #1, biological metrics, and dominant macroinvertebrate taxa percentages were conducted to determine what was driving the ordination (Table 2). The eigen values for axis 1 during both sampling seasons were slightly higher than the original ordination that included both sampling regimes for the NFSR samples. The eigen values for the fall sampling season were 0.47 for axis 1 and 0.20 for axis 2. The eigen values for the spring sampling season were 0.34 for axis 1 and 0.19 for axis 2.

With a few exceptions, both DCA analyses showed that most of the NFSR samples ordinated closer to most LDC samples. The first exception was that three LDC samples during the fall sampling season and four during the spring sampling season ordinated closer to most of the Cedar and Horse creek samples than the other LDC and NFSR samples. The second exception was that Cedar and Horse creek samples collected during this study ordinated closer to NFSR stations #2-#10 and most of the LDC samples than Cedar and Horse samples collected in earlier years. This was most likely caused by very low water levels at Cedar and Horse creeks during the summer and fall of 2006. Both streams were pooled for months during this time period and no coarse substrate for macroinvertebrates was collected during the fall 2006 sampling season. The coarse substrate was sampled during the spring 2007 sampling season, but the macroinvertebrate community most likely had not recovered from the drought conditions of the previous year. The third exception, which was more strongly evident in the first ordination, showed that NFSR #5, during the spring 2007 sampling season, had a different macroinvertebrate community compared to the other sampling stations.

Figure 3
Detrended Correspondence Analysis (DCA) for the Fall (Top) and Spring (Bottom) Sampling Seasons From Samples Collected at North Fork of the Spring River (NFSR) Test Stations and Reference Stations on Cedar (CC), Horse (HC), and Little Drywood Creeks (LDC). Both Riffle/Pool (RP) and Glide/Pool (GP) Sampling Regimes Were Included in the Analysis at NFSR Test Stations That Had Available Coarse (CS) Substrate.

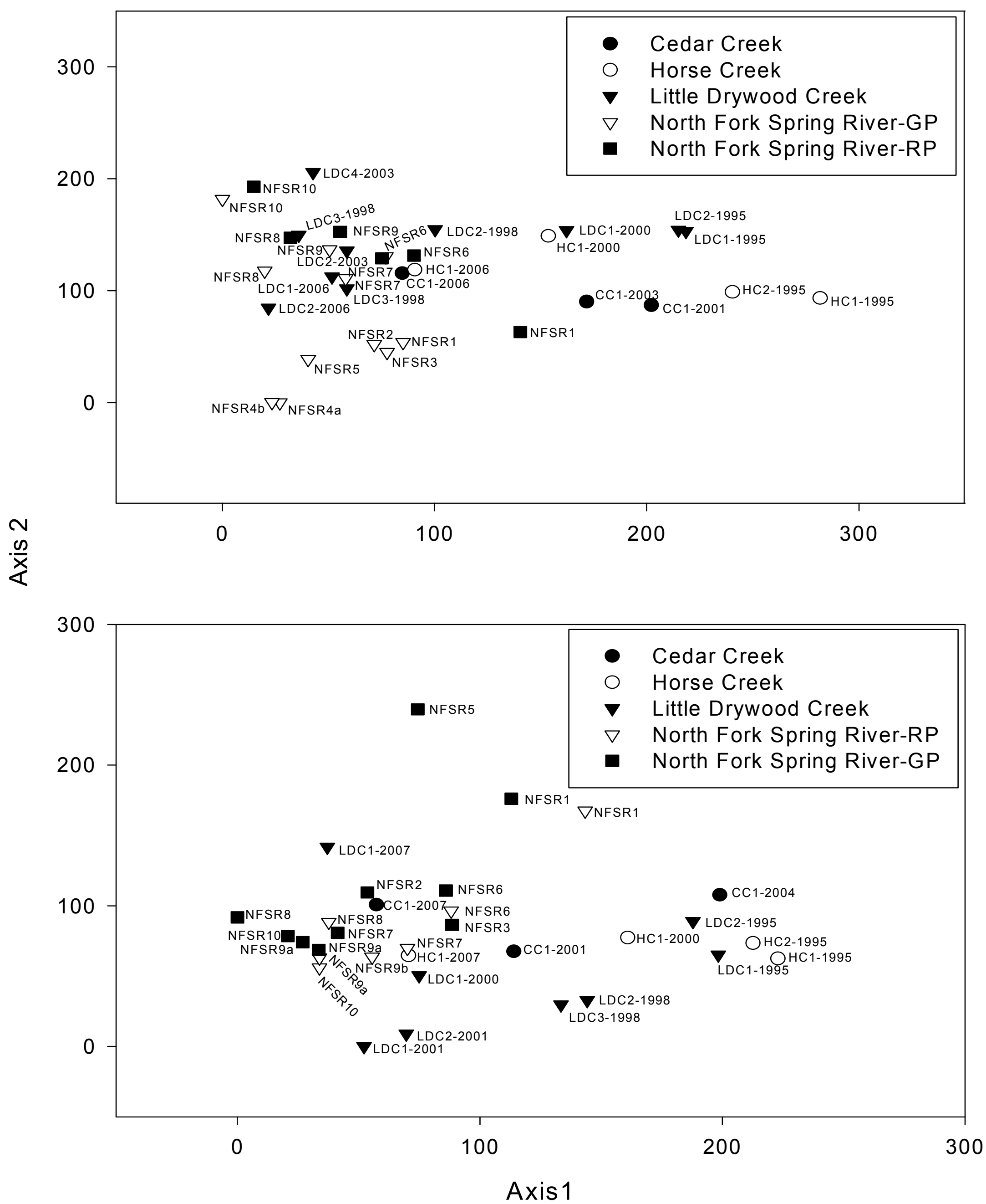
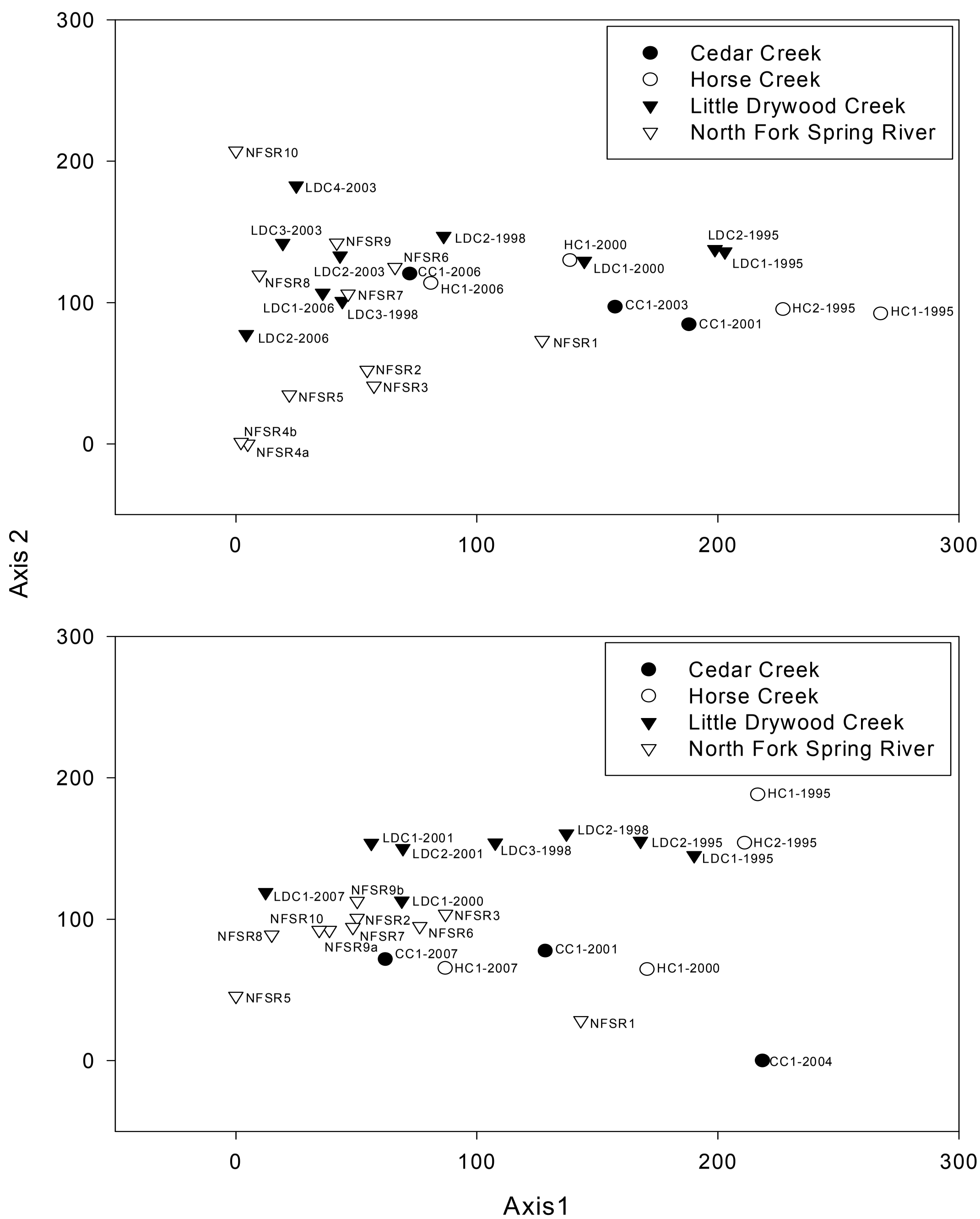


Figure 4
Detrended Correspondence Analysis (DCA) for the Fall (Top) and Spring (Bottom) Sampling Seasons From Samples Collected at North Fork of the Spring River (NFSR) Test Stations and Reference Stations on Cedar (CC), Horse (HC), and Little Drywood Creeks (LDC). Riffle/Pool (RP) Data at NFSR #1 and Glide/Pool (GP) Data at the Other NFSR Test Stations Were Used in the Analysis.



Spearman rank correlation comparing DCA axis 1 to the four primary biological metrics and macroinvertebrate groups was done to determine differences in macroinvertebrate community structure and function between the NFSR test stations and samples collected at the biological criteria reference stations (Table 2). Horse Creek, Cedar Creek, and the LDC samples that ordinated on the right side of axis 1 had a higher abundance and diversity of intolerant EPT taxa and lower abundance of tolerant Chironomidae and Tubificidae taxa. During the fall sampling season the three LDC samples (950888, 950889, and 0010124) that ordinated near Horse and Cedar Creeks had a higher abundance of EPT taxa (especially Heptageniide taxa and *Stenacron)* and lower abundance of Chironomidae taxa *Dicrotendipes* and *Glyptotendipes*. During the spring sampling season the four LDC samples (950851, 950852, 982810, and 982811) that ordinated closer to Horse Creek and Cedar Creek had higher abundance and diversity of EPT taxa and Simulidae and less abundance of Physidae and Chironomidae taxa *Hydrobaenus* and *Cricotopus/Orthocladius* group. These general differences in macroinvertebrate community structure most likely caused the three LDC samples during the fall sampling season and the four samples during the spring sampling season to ordinate closer to Horse Creek and Cedar Creek.

3.1.2 Macroinvertebrate Percent and Community Composition

Percent EPTT, percent Ephemeroptera, percent Plecoptera, percent Trichoptera, percent composition for the functional feeding groups, percent clingers, and percent composition of the five dominant macroinvertebrate families and taxa at each station are presented in Tables 3 through 6. Values in the tables in bold type represent the five dominant macroinvertebrate families and taxa for each station.

During the fall 2006 sampling season, North Fork of the Spring River test stations #4a, #4b, #5, and #10 had a lower percentage of EPTT, scrapers, and clingers than the other NFSR test stations and all of the biological criteria reference stations, except Cedar Creek #1 (Table 3). *Caenis latipennis* was the only abundant EPTT found in the samples from the NFSR test stations (Table 5). *Stenacron*, a Heptageniide mayfly, was common in the LDC samples, but was found in low abundances in the other samples. Percent shredders were much higher at NFSR test stations #2, #4a, #4b, and #5 and were primarily caused by the high abundance of the tolerant taxa *Glyptotendipes* in the SG habitat.

Chironomidae and Tubificidae were very abundant at all stations during the fall 2006 sampling season. *Glyptotendipes* and *Dicrotendipes* were the most common Chironomidae taxa at most stations. Other Chironomidae taxa like *Goeldochironomus*, *Kiefferulus*, and *Procladius* were common at some stations. The Tubificidae taxa *Quistradrilus multisetosus* was common at the lower NFSR test stations while *Branchiuria sowerbyi* was common at the upper NFSR test stations. *Hyalella azteca* was abundant at Cedar Creek, Horse Creek, and most of the NFSR test stations. Test station #1 was assessed as an RP stream type and had three taxa, Corixidae, *Polypedilum convictum,* and *Stenelmis,* that had higher abundances than the other test stations. *Polypedilum convictum* and *Stenelmis* are primarily collected in CS habitat and are not commonly collected in habitats sampled in GP streams.

Table 2
Two-Tailed Spearman Rank Correlation Coefficient (*p* Value) Values Between DCA Axis 1, Biological Metrics, and Macroinvertebrate Groups for Fall and Spring Sampling Seasons

	DCA Axis 1 (Fall)	**DCA Axis 1 (Spring)**
Biological Metrics		
Taxa Richness	0.33 (0.09)	0.35 (0.09)
EPT Taxa	**0.77 (0.00)**	**0.82 (0.00)**
Biotic Index	**-0.78 (0.00)**	**-0.86 (0.00)**
Shannon Diversity Index	**0.55 (0.00)**	**0.75 (0.00)**
Percent Macroinvertebrate Groups		
Clingers	**0.80 (0.00)**	**0.89 (0.00)**
EPT	**0.68 (0.00)**	**0.86 (0.00)**
Ephemeroptera	**0.62 (0.00)**	**0.72 (0.00)**
Plecoptera	**-**	**0.79 (0.00)**
Trichoptera	**0.74 (0.00)**	**0.78 (0.00)**
Heptageniidae	**0.67 (0.00)**	**0.76 (0.00)**
Stenacron	**0.61 (0.00)**	**0.46 (0.02)**
Caenidae	0.12 (0.55)	**0.47 (0.02)**
Leptophlebiidae	**0.47 (0.01)**	**0.63 (0.00)**
Perlidae	**-**	**0.70 (0.00)**
Perlodidae	**-**	**0.72 (0.00)**
Hydropsychidae	**0.71 (0.00)**	**0.64 (0.00)**
Elmidae	**0.61 (0.00)**	**0.58 (0.00)**
Chironomidae	-0.30 (0.12)	**-0.41 (0.04)**
Glyptotendipes	**-0.86 (0.00)**	-0.27 (0.20)
Dicrotendipes	**-0.40 (0.03)**	**-0.45 (0.03)**
Polypedilum Convictum	**0.52 (0.00)**	**0.73 (0.00)**
Hydrobaenus	-0.35 (0.07)	**-0.42 (0.04)**
Cricotpous/Orthocladius Group	**0.58 (0.00)**	-0.26 (0.21)
Simulidae	**0.40 (0.04)**	**0.42 (0.04)**
Tubificidae	**-0.64 (0.00)**	-0.28 (0.18)
Hyalellidae	0.26 (0.19)	**0.55 (0.00)**
Physidae	-0.28 (0.15)	**-0.68 (0.00)**

Values in Bold are Significant at $p < 0.05$.

During the spring 2007 sampling season percent EPTT were low at most stations. Percent scrapers were higher at the upper NFSR stations (Tables 5 and 6) and were composed predominately of the tolerant taxa *Hydrobaenus* and *Physella*. Percent EPTT were higher at the other NFSR test stations, but were dominated by the taxa *Caenis latipennis*. Little Drywood Creek #1 and all of the NFSR test stations except stations #1 and #7 had low values for percent clingers compared to Cedar and Horse creeks. Elmidae and *Paratendipes* made up most of the

clingers at test station #1 while *Simulium* made up most of the clingers at test station #7. *Isoperla* and some Elmidae made up most of the clingers at Cedar Creek while *Perlesta*, *Simulium*, and Elmidae made up most of the clingers at Horse Creek.

Chironomidae were the most abundant family found in all of the NFSR test stations during the spring 2007 sampling season, ranging from 38.4 percent at station #2 to 65.5 percent at station #9a (Table 5). *Cricotopus/Orthocladius* group and *Hydrobaenus* were very abundant at most of the NFSR test stations (Table 6). *Hydrobaenus* tended to be more abundant at the upper test stations while *Cricotopus/Orthocladius* group was abundant at all of the stations, except station #5. The *Eukiefferiella brevicalicar* group was abundant at Cedar Creek, Horse Creek, and the upper NFSR test stations. Tubificidae worms also made up a significant portion of the samples ranging from 3.4 percent at test station #6 to 20.8 percent at test station #10. *Physella* made up a significant portion at half of the NFSR test stations and LDC #1, ranging from 5.1 percent at test station #9a to 15.7 percent at test station #8. Detrended Correspondence Analysis showed that test station #5 had a distinctively different macroinvertebrate community than the other test stations and was dominated by *Dicrotendipes, Glyptotendipes, Procladius*, and Planaridae (Figures 2 and 3; Table 6).

Table 3
Biological Metric Values and Top Five Dominant Macroinvertebrate Families at the NFSR Stressor Study Sampling Stations
Fall 2006

Variable-Station	NFSR #1	NFSR #2	NFSR #3	NFSR #4a	NFSR #4b	NFSR #5	NFSR #6	NFSR #7	NFSR #8	NFSR #9	NFSR #10	Cedar Ck. #1	Horse Ck. #1	LDC #1	LDC #2
Biological Metrics															
% EPTT	8.1	15.1	5.6	2.4	2.4	1.5	15.7	18.4	7.1	9.1	0.9	0.8	12.1	12.3	5.8
% Ephemeroptera	7.2	15.1	4.6	2.3	2.3	1.5	15.3	16.3	7.0	9.1	0.9	0.8	12.0	11.9	5.8
% Plecoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Trichoptera	0.9	0	1.0	0.1	0.1	0	0.5	2.1	0.1	0	0	0	0.1	0.4	0
% Scrapers	12.8	1.5	4.6	0.6	0.8	0.9	12.6	8.0	7.1	7.6	6.0	5.1	4.3	13.1	5.6
% Shredders	16.1	28.3	6.8	33.9	32.8	36.3	8.0	20.0	22.0	10.8	9.3	6.5	3.0	23.2	25.9
% Collectors	53.9	60.7	64.2	50.8	54.7	40.0	59.3	55.3	48.4	64.3	66.5	72.0	72.4	35.4	27.6
% Filters	2.0	1.1	0.9	0.2	0.5	1.4	2.1	1.6	2.6	2.4	9.6	1.3	0.3	1.7	0.8
% Predators	15.9	8.4	22.5	14.3	11.4	21.7	18.5	16.0	21.1	16.0	8.5	15.5	20.4	27.7	39.9
% Clingers	15.9	2.3	3.3	0.8	0.3	0.2	9.7	2.6	1.8	3.4	0.7	0.3	7.3	10.1	6.0
% Dominant Families															
Chironomidae	**23.3**	**50.8**	**30.7**	**40.5**	**39.6**	**49.3**	**37.3**	**33.0**	**59.6**	**49.6**	**40.0**	**34.4**	**23.3**	**42.8**	**62.0**
Tubificidae	**21.1**	**13.6**	**10.2**	**26.2**	**30.8**	**10.1**	**9.2**	**16.4**	**11.5**	**18.3**	**34.3**	**21.4**	**22.3**	**15.7**	**6.6**
Elmidae	**14.0**	0.7	0.1	0.3	0.3	0.1	**5.6**	1.0	0.8	2.0	0.5	0.3	**7.0**	0.8	0.7
Hyalellidae	**12.0**	**9.7**	**28.5**	**8.8**	**9.4**	**18.7**	**8.3**	**4.8**	0	0.1	0	**19.5**	**15.1**	3.7	1.2
Corixidae	**7.4**	1.2	1.1	0.2	0.5	1.1	0.1	0	0.6	0.5	0.1	0.3	0	2.2	0.2
Caenidae	5.7	**12.3**	1.1	2.3	2.2	1.3	**11.0**	**14.9**	**6.2**	**7.7**	0.9	0.3	**10.8**	0.6	0.7
Scirtidae	1.0	**2.1**	1.5	**7.5**	**6.1**	1.9	1.7	**3.4**	1.0	0.6	1.2	2.7	0.3	0.6	0.2
Chaoboride	0.1	0.6	**12.6**	3.3	1.3	**6.2**	1.5	2.2	2.6	1.5	0.1	2.5	2.5	**4.0**	**13.4**
Heptageniidae	0.9	1.0	**2.4**	0	0	0.1	3.9	1.0	0.6	1.2	0	0	0.1	**9.0**	**4.8**
Ceratopogonidae	0.6	0.5	1.4	**5.7**	**2.6**	**2.2**	0.8	3.3	0.5	0.8	**3.5**	3.2	0.9	1.8	1.0
Arachnoidea	1.2	0.5	2.3	1.3	2.3	1.0	1.2	1.2	**3.2**	2.0	0.5	0.8	5.0	**6.3**	**6.3**
Physidae	1.0	0.1	0.9	0	0.3	0.7	3.5	3.0	**2.6**	1.2	**2.0**	**3.7**	0.7	2.3	0.2
Planorbidae	1.3	0.1	0.9	0.2	0.2	0	2.9	2.1	**2.6**	**2.4**	0.8	1.2	2.8	0.7	0.3
Planariidae	0.1	0.5	0.4	0	1.4	1.6	0	0.9	0.9	**3.2**	0.1	**3.5**	1.5	1.0	0
Sphaeridae	1.2	0.2	0.1	0.2	0.2	0	2.0	0.9	2.1	1.1	**8.0**	1.3	0.1	0	0.7

Table 4
Top Five Dominant Macroinvertebrate Taxa at the NFSR Stressor Study Sampling Stations, Fall 2006

Variable-Station	Biotic Index	NFSR #1	NFSR #2	NFSR #3	NFSR #4a	NFSR #4b	NFSR #5	NFSR #6	NFSR #7	NFSR #8	NFSR #9	NFSR #10	Cedar Ck. #1	Horse Ck. #1	LDC #1	LDC #2
% Dominant Taxa																
Tubificidae	9.2	**13.3**	6.1	**5.2**	3.0	**5.6**	**5.1**	4.4	**8.9**	**5.4**	**8.2**	**20.4**	**18.0**	**18.4**	**11.4**	**6.3**
Hyalella azteca	7.9	**12.0**	**9.7**	**28.5**	**8.8**	**9.4**	**18.7**	**8.3**	4.8	0	0.1	0	**19.5**	**15.1**	3.7	1.2
P. convictum	5.3	**8.8**	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stenelmis	5.4	**8.2**	0.1	0	0	0	0	0.2	0	0	0.7	0.4	0	0	0	0
Corixidae	6.0	**6.7**	1.2	1.1	0.2	0.5	1.0	0.1	0	0.6	0.5	0.1	0.3	0	2.2	0.2
Glyptotendipes	8.5	2.6	**23.0**	3.0	**18.9**	**21.9**	**33.7**	4.9	**14.8**	**21.0**	**9.0**	7.8	3.5	1.8	**21.5**	**24.6**
Caenis latipennis	7.6	5.7	**12.3**	1.1	2.3	2.2	1.3	**11.0**	**14.9**	**6.2**	**7.7**	0.9	0.3	**10.8**	0.6	0.7
Tanytarsus	6.7	3.6	**10.1**	2.5	2.4	2.0	**3.9**	2.3	2.7	0.6	3.3	0.7	**5.2**	1.8	1.4	0.2
Dicrotendipes	7.9	1.4	**7.2**	**11.2**	4.3	5.1	1.7	**8.4**	**7.3**	**16.2**	**18.9**	6.6	**7.2**	0.7	3.7	**8.5**
Chaoborus	8.5	0.1	0.6	**12.6**	3.3	1.3	**6.2**	1.5	2.2	2.6	1.5	0.1	2.5	2.5	4.0	**13.5**
Tribelos	6.6	0.1	0.7	**6.5**	0.4	0.1	0.2	1.5	0	1.2	1.4	0	0	0.4	0.8	3.2
Aulodrilus	8.0	1.7	2.2	2.1	**10.7**	**17.5**	1.7	0.9	0.7	0.1	0.1	0	0	1.9	0	0
Quistradrilus	10.0	4.2	4.3	1.0	**10.2**	5.5	1.0	0.2	0.3	0	0	0	0.9	0.9	0	0
Scirtidae	5.0	1.0	2.1	1.5	**7.5**	**6.1**	1.9	1.7	3.4	1.0	0.6	1.2	2.7	0.3	0.6	0.2
Procladius	9.3	0.3	1.0	2.1	1.7	1.9	**3.9**	**5.6**	**0.8**	5.1	2.8	0.3	1.3	4.3	**9.8**	**16.3**
Kiefferulus	10.0	0.3	1.2	0	2.2	1.6	0.3	**6.9**	**0.8**	**7.5**	6.5	**9.1**	1.6	**8.4**	1.4	3.7
Branchiuria	8.4	0	0	0.2	0.5	0.5	0.6	1.8	**5.5**	**4.6**	**9.2**	**10.7**	1.5	4.3	1.7	0
Goeldochironomus	9.0	0	0.3	0	0.2	0.2	0.2	0.3	0.6	0	0.1	**9.6**	3.9	0.1	0	0
Sphaeridae	7.3	1.2	0.2	0.2	0.2	0.2	0.1	2.0	1.0	2.1	1.1	**8.0**	1.3	0.3	1.1	0.7
Stenacron	7.1	0.6	0.9	2.4	0	0	0.1	2.9	0.8	0.6	0.5	0	0	0.1	**8.8**	4.8
Acarina	5.7	1.2	0.5	2.3	1.3	2.3	1.0	1.2	1.2	3.2	2.0	0.5	0.8	5.0	**6.3**	**6.3**
Dubiraphia	6.4	5.8	0.6	0.1	0.3	0.3	0.1	5.4	0.9	0.8	0.7	0.1	0.3	**6.4**	0.8	0.7
Chironomus	9.8	0.1	0	0	0.8	0.6	0.5	0.1	0.3	0.5	1.7	3.4	**8.7**	2.1	0.8	1.5

Table 5
Biological Metric Values and Top Five Dominant Macroinvertebrate Families at the NFSR Stressor Study Sampling Stations
Spring 2007

Variable-Station	NFSR #1	NFSR #2	NFSR #3	NFSR #5	NFSR #6	NFSR #7	NFSR #8	NFSR #9a	NFSR #9b	NFSR #10	Cedar Ck. #1	Horse Ck. #1	LDC #1
Biological Metrics													
% EPTT	4.6	6.3	8.0	4.0	10.8	6.5	1.0	1.6	1.6	0.4	5.7	5.8	3.6
% Ephemeroptera	3.8	6.0	7.6	3.8	10.6	6.2	0.8	1.4	1.1	0.4	0.6	2.2	3.4
% Plecoptera	0.1	0.2	0	0	0.1	0.1	0	0.1	0.2	0	5.1	3.0	0
% Trichoptera	0.7	0.2	0.4	0.2	0.1	0.2	0.1	0.1	0.2	0	0.1	0.6	0.3
% Scrapers	9.9	27.0	6.3	5.0	12.8	21.8	42.9	28.6	37.2	29.0	22.2	14.2	15.9
% Shredders	33.5	10.0	31.6	30.3	34.8	21.4	10.7	27.2	23.2	27.9	21.7	11.1	11.8
% Collectors	42.9	52.6	50.9	45.4	36.0	42.8	36.1	32.1	28.9	33.0	38.4	54.9	60.5
% Filters	1.2	1.4	4.7	1.2	1.4	7.3	2.1	3.4	3.8	2.8	1.5	8.3	1.2
% Predators	13.3	8.2	6.3	19.0	16.1	4.8	7.8	8.6	6.8	7.0	23.3	11.8	9.1
% Clingers	10.3	1.6	4.8	0.3	2.6	7.2	1.9	3.0	3.9	0	6.2	12.7	1.1
% Dominant Families													
Chironomidae	**60.4**	**38.4**	**40.0**	**56.5**	**62.3**	**52.4**	**41.9**	**65.5**	**60.8**	**63.8**	**57.7**	**55.5**	**20.0**
Tubificidae	**14.1**	**14.0**	**16.9**	**12.2**	3.4	**9.8**	**21.0**	**11.3**	**15.2**	**20.8**	**12.6**	**14.0**	**11.1**
Hyalellidae	**5.3**	**7.2**	**9.0**	3.6	**5.1**	0.4	0	0	0	0.6	**4.7**	0.3	1.2
Elmidae	**4.8**	0.2	0	0	0.7	0.1	0.4	0.5	0.1	0	0.9	1.9	0.2
Caenidae	**3.6**	5.9	**6.8**	**3.8**	**10.0**	**6.2**	0.8	1.3	1.1	0.4	0.2	2.2	2.7
Asellidae	0.2	**15.6**	**8.2**	**4.3**	**4.4**	3.7	**4.2**	0.8	1.6	0.4	0.5	1.9	**35.6**
Physidae	0.4	**9.2**	2.8	1.2	1.4	**11.6**	**15.7**	**5.1**	**9.2**	0.8	1.7	0.3	**11.3**
Planariidae	0	0.3	0	**8.6**	0	0.3	0.1	1.4	0.3	0	0.2	0	0
Ceratopogonidae	1.9	2.6	2.2	3.4	**6.5**	1.4	2.9	**2.6**	**2.3**	**4.8**	2.9	1.3	2.1
Hydrobiidae	1.5	0	0.1	0.3	0.4	0.5	**3.7**	0.7	0.5	0.2	0	0.6	1.9
Arachnoidea	1.3	1.0	0.6	0.9	1.0	0.1	1.1	**2.7**	1.0	0.8	1.6	0.8	0.2
Sphaeridae	0.6	0.3	0.3	1.2	0.8	0.2	0.8	1.1	0.6	**2.7**	1.0	1.5	0.9
Dytiscidae	0.7	0.4	0.2	0	0	0.2	1.0	1.3	1.3	1.0	**5.6**	0.5	**3.6**
Perlodidae	0.1	0	0	0	0	0	0	0.1	0	0	**4.7**	0.2	0
Simulidae	0.3	1.0	4.4	0.1	0.5	**6.9**	1.2	2.3	**3.0**	0	0.5	**6.8**	0.4
Enchytraeidae	0.4	0	4.0	0.4	0.2	0.2	1.5	0.4	0	**2.3**	1.3	**4.6**	1.2
Perlidae	0	0.2	0	0	0.1	0.1	0	0	0.2	0	0	**2.7**	0

Table 6
Top Five Dominant Macroinvertebrate Taxa at the NFSR Stressor Study Sampling Stations, Spring 2007

Variable-Station	Biotic Index	NFSR #1	NFSR #2	NFSR #3	NFSR #5	NFSR #6	NFSR #7	NFSR #8	NFSR #9a	NFSR #9b	NFSR #10	Cedar Ck. #1	Horse Ck. #1	LDC #1
% Dominant Taxa														
Cricotopus/Orthocladius Group	6.5	**12.8**	**9.1**	**30.7**	2.9	**30.3**	**19.9**	**9.7**	**25.4**	**22.0**	**25.7**	**18.8**	**9.7**	**9.1**
Polypedilum scaleanum Group	8.7	**9.2**	0	0	0.4	0	0	0	0	0	0	0	0	0.5
Tanytarsus	6.7	**6.8**	1.4	1.0	0.3	0.6	0.5	0.8	0.7	0.9	0.1	0.7	1.5	0.7
Tubificidae	9.2	**6.7**	**12.2**	**10.2**	**6.0**	2.1	**8.9**	**16.1**	**7.7**	**13.1**	**10.7**	**8.2**	**11.8**	**8.0**
Polypedilum convictum Group	5.3	**6.3**	0	0	0	0	0	0	0	0	0	0	0	0
Hydrobaenus	9.6	3.9	**16.9**	2.5	2.2	**9.9**	**9.0**	**22.7**	**21.9**	**26.4**	**27.7**	**19.0**	**11.4**	1.5
Lirceus	7.7	0.2	**15.6**	**8.2**	4.3	4.4	3.7	**4.2**	0.8	1.6	0.3	0.6	1.9	**35.6**
Physella	9.1	0.4	**9.2**	2.8	1.2	1.4	**11.6**	**15.7**	5.1	**9.2**	0.8	1.7	0.3	**11.3**
Hyalella azteca	7.9	5.3	7.2	**9.0**	3.6	5.1	0.4	0	0	0	0.6	4.7	0.3	1.2
Caenis latipennis	7.6	3.6	5.9	**6.8**	3.8	**10.0**	6.2	0.8	1.3	1.2	0.4	0.2	2.2	2.7
Glyptotendipes	8.5	1.3	0.4	0.3	**22.9**	0.4	1.0	0.2	1.6	0.6	2.1	1.1	0.5	1.8
Procladius	9.3	5.6	0.8	0.8	**11.4**	**5.8**	0	0.6	0.1	0	0.5	**5.8**	4.5	1.8
Planariidae	7.5	0	0.3	0	**8.6**	0	0.3	0.1	1.4	0.3	0	0.2	0	0
Dicrotendipes	7.9	1.5	1.6	1.3	**8.4**	4.1	5.8	1.3	**5.3**	1.5	3.4	0	0.7	1.0
Ceratopogoninae	6.0	1.9	0	2.2	3.3	**6.5**	1.4	2.9	2.1	2.1	**3.8**	2.9	1.3	2.1
Eukiefferiella brevicalicar Group	4.0	1.0	1.0	1.5	0.2	1.9	**10.4**	2.8	**8.4**	**6.8**	0	**6.5**	**16.6**	1.8
Illyodrilus templetoni	9.4	1.5	0	1.0	3.0	0	0	0.6	0.4	0	**4.6**	0	0.1	0.7
Neoporus	8.9	0	0	0	0	0	0	1.0	0	0	0.7	5.6	0.5	**3.6**
Simulium	4.4	0.3	1.0	4.4	0.1	0	6.9	1.2	2.3	3.1	0	0.4	**6.8**	0.4

3.1.3 Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure (SMSBPP)

Riffle/pool biological criteria were calculated from Cedar and Horse creeks, two biological criteria reference streams in a transitional area of the Ozark/Osage EDU. These criteria were used to assess NFSR #1 and reference stations on Cedar and Horse creeks (Tables 7 and 9). All other NFSR test stations and reference stations on Little Drywood Creek were assessed using GP biological criteria from the Central Plains/Osage/South Grand EDU (Tables 8 and 10). Values in bold are biological metric values that scored a 1 or 3 based on biological criteria. The low MSCI scores for Cedar and Horse creeks were most likely caused by low water levels and no coarse substrate available to sample.

Table 7
Fall 2006 Ozark/Osage EDU Transitional Area Stream Biological Criteria, Biological Support Categories, and Macroinvertebrate Stream Condition Index (MSCI) Scores for the North Fork of the Spring River (NFSR) Stressor Study

Stream and Station Number	Sample No.	TR	EPTT	BI	SDI	MSCI	Support
NFSR #1	0602717	81(5)	**9(3)**	**7.48(3)**	3.20(5)	16	F
Horse Creek #1	0602728	**52(3)**	**4(1)**	**8.23(3)**	**2.89(3)**	10	**P**
Cedar Creek #1	0602729	**44(3)**	**2(1)**	**8.30(3)**	**2.83(3)**	10	**P**
Metric Score=5	if	>79	>14	<6.88	>3.13	20-16	**F**ull
Metric Score=3	if	79-40	14-7	6.88-8.44	3.13-1.56	14-10	**P**artial
Metric Score=1	if	<40	<7	>8.44	<1.56	8-4	**N**on

Individual Metric Score in parentheses; MSCI Scoring Table (in light gray) developed from BIOREF streams (n=5); TR=taxa richness; EPTT=Ephemeroptera, Plecoptera, Trichoptera Taxa; BI=Biotic Index; SDI=Shannon Diversity Index

North Fork of the Spring River test stations #4a, #4b, #5, and #10 had MSCI scores that scored in the partial sustainability category during the fall sampling season (Table 8). All of the other NFSR test stations had MSCI scores that scored in the full sustainability category. Most of the test stations that scored in the full sustainability category had MSCI scores of 16 while the MSCI scores were 14 for most of the test stations that scored in the partial sustainability category. All of the NFSR test stations had low biological metric scores for EPTT and BI. EPTT was much lower and BI was much higher at the test stations that scored in the partial sustainability range. Rootmat was not available at LDC #2.

All of the biological criteria reference stations, except LDC #1, had low MSCI scores and scored in the partial sustainability category during the fall 2006 sampling season (Tables 7 and 8).

Table 8
Fall 2006 Central Plains/Osage/South Grand EDU Biological Criteria, Biological Support Categories, and Macroinvertebrate Stream Condition Index (MSCI) Scores for the North Fork of the Spring River (NFSR) Stressor Study

Stream and Station Number	Sample No.	TR	EPTT	BI	SDI	MSCI	Support
LDC #1	0602715	58(5)	7(5)	**8.22(3)**	2.97(5)	18	F
LDC #2	0602716	**46(3)**	**4(3)**	**8.53(3)**	**2.53(3)**	12	**P**
NFSR #2	0602718	68(5)	**6(3)**	**8.19(3)**	2.88(5)	16	F
NFSR #3	0602719	57(5)	8(5)	**7.90(3)**	**2.78(3)**	16	F
NFSR #4a	0602720	**53(3)**	**2(1)**	**8.29(3)**	2.90(5)	12	**P**
NFSR #4b	0602722	57(5)	**3(3)**	**8.30(3)**	**2.78(3)**	14	**P**
NFSR #5	0602721	61(5)	**3(3)**	**8.56(3)**	**2.58(3)**	14	**P**
NFSR #6	0602723	74(5)	**6(3)**	**8.01(3)**	3.36(5)	16	F
NFSR #7	0602724	88(5)	8(5)	**8.05(3)**	3.26(5)	18	F
NFSR #8	0602725	67(5)	**4(3)**	**8.49(3)**	2.94(5)	16	F
NFSR #9	0602726	63(5)	**4(3)**	**8.28(3)**	3.11(5)	16	F
NFSR #10	0602727	66(5)	**1(1)**	**8.62(3)**	2.85(5)	14	**P**
Metric Score=5	if	>55	>6	<7.73	>2.84	20-16	**F**ull
Metric Score=3	if	55-28	6-3	7.73-8.86	2.84-1.42	14-10	**P**artial
Metric Score=1	if	<28	<3	>8.86	<1.42	8-4	**N**on

Individual Metric Score in parentheses; MSCI Scoring Table (in light gray) developed from BIOREF streams (n=13); TR=taxa richness; EPTT=Ephemeroptera, Plecoptera, Trichoptera Taxa; BI=Biotic Index; SDI=Shannon Diversity Index

During the spring 2007 sampling season biological criteria reference stations on Cedar and Horse creeks scored in the partial sustainability category and LDC #1 scored in the full sustainability category (Tables 9 and 10). By the spring 2007 sampling season, CS was available on Cedar and

Horse creeks since the water levels were up from the low levels during the previous fall sampling season. The low MSCI and biological metric scores compared to previous samples collected on these streams indicated that the macroinvertebrate community had not recovered from the low water levels that occurred during the previous summer and fall.

North Fork of the Spring River test stations #1, #7, #8, #9b, and #10 had MSCI scores that scored in the partial sustainability category during the spring 2007 sampling season. All of the other NFSR test stations had MSCI scores that scored in the full sustainability category. All of the test stations that scored in the full sustainability category had MSCI scores of 16 while the MSCI scores were 12 or 14 for the test stations that scored in the partial sustainability category. All of the NFSR test stations had low biological metric scores for EPTT and BI. EPTT was extremely low at test stations #7 through #10 and was the primary reason why most of these stations had MSCI scores in the partial sustainability category.

Table 9
Spring 2007 Ozark/Osage EDU Transitional Area Stream Biological Criteria, Biological Support Categories, and Macroinvertebrate Stream Condition Index (MSCI) Scores for the North Fork of the Spring River (NFSR) Stressor Study

Stream and Station Number	Sample No.	TR	EPTT	BI	SDI	MSCI	Support
NFSR #1	0703244	**72(3)**	**9(3)**	**7.58(3)**	**3.28(3)**	12	**P**
Horse Creek #1	0703241	85(5)	**8(3)**	**6.72(3)**	**3.09(3)**	14	**P**
Cedar Creek #1	0703242	**59(3)**	**8(3)**	**7.52(3)**	**2.86(3)**	12	**P**
Metric Score=5	if	>77	>17	<6.38	>3.30	20-16	**F**ull
Metric Score=3	if	77-39	17-8	6.38-8.19	3.30-1.65	14-10	**P**artial
Metric Score=1	if	<39	<8	>8.19	<1.65	8-4	**N**on

Individual Metric Score in parentheses; MSCI Scoring Table (in light gray) developed from BIOREF streams (n=5); TR=taxa richness; EPTT=Ephemeroptera, Plecoptera, Trichoptera Taxa; BI=Biotic Index; SDI=Shannon Diversity Index

Table 10
Spring 2007 Central Plains/Osage/South Grand EDU Biological Criteria, Biological Support Categories, and Macroinvertebrate Stream Condition Index (MSCI) Scores for the North Fork of the Spring River (NFSR) Stressor Study

Stream and Station Number	Sample No.	TR	EPTT	BI	SDI	MSCI	Support
LDC #1	0703250	55(5)	**6(3)**	**7.92(3)**	2.60(5)	16	F
NFSR #2	0703253	61(5)	**5(3)**	**8.10(3)**	2.80(5)	16	F
NFSR #3	0703252	60(5)	**6(3)**	**7.54(3)**	2.67(5)	16	F
NFSR #5	0703245	69(5)	**5(3)**	**8.25(3)**	2.94(5)	16	F
NFSR #6	0703246	61(5)	**6(3)**	**7.36(3)**	2.72(5)	16	F
NFSR #7	0703251	57(5)	**3(1)**	**7.30(3)**	2.76(5)	14	**P**
NFSR #8	0703249	58(5)	**2(1)**	**8.32(3)**	2.70(5)	14	**P**
NFSR #9a	0703247	55(5)	**4(3)**	**7.57(3)**	2.59(5)	16	F
NFSR #9b	0703248	**50(3)**	**3(1)**	**7.81(3)**	2.42(5)	12	**P**
NFSR #10	0703243	**43(3)**	**1(1)**	**8.09(3)**	2.40(5)	12	**P**
Metric Score=5	if	>50	>8	<7.16	>2.29	20-16	**F**ull
Metric Score=3	if	50-25	8-4	7.16-8.58	2.29-1.14	14-10	**P**artial
Metric Score=1	if	<25	<4	>8.58	<1.14	8-4	**N**on

Individual Metric Score in parentheses; MSCI Scoring Table (in light gray) developed from BIOREF streams (n=9); TR=taxa richness; EPTT=Ephemeroptera, Plecoptera, Trichoptera Taxa; BI=Biotic Index; SDI=Shannon Diversity Index

3.2 Physicochemical Water Sample Collection and Analysis

3.2.1 Summer Datalogger Data

Previous studies on the NFSR have indicated that the stream had low dissolved oxygen levels during low flow periods in the summer and early fall (MDNR 2004; MDNR 2005; MDNR 2006a). Dataloggers were deployed and set to collect dissolved oxygen and water temperature data every 15 minutes at NFSR #1, NFSR #2, NFSR #6, NFSR #9, and Horse Creek #1 during the summer of 2006 (Figures 5-14 and Appendix D).

At NFSR #6 a datalogger was deployed from July 31 to August 3, 2006 (Figures 5 and 6). The diurnal dissolved oxygen fluctuations were small with values during the datalogger deployment period ranging from 2.80 mg/L to 5.19 mg/L. The lowest dissolved oxygen values generally occurred in the late morning hours of each day. The percentage of the readings that were below the dissolved oxygen criteria of 5 mg/L was 98.97 percent.

At NFSR #1 a datalogger was deployed from August 7-10, 2006 (Figures 7 and 8). The diurnal dissolved oxygen fluctuations ranged from 1.75 mg/L to 7.03 mg/L. The lowest dissolved oxygen levels were normally in the early morning hours. The percentage of the readings that were below the dissolved oxygen criteria of 5 mg/L was 79.53 percent.

At NFSR #3 a datalogger was deployed from August 7-10, 2006 (Figures 9 and 10). Dissolved oxygen readings and diurnal fluctuations were low with readings ranging from 0.33 mg/L to 3.57 mg/L. The lowest dissolved oxygen readings were normally collected in the early afternoon hours. All of the dissolved oxygen readings were below the dissolved oxygen criteria of 5 mg/L.

At NFSR #9 a datalogger was deployed from August 28-31, 2006 (Figures 11 and 12). The diurnal dissolved oxygen fluctuations were small at NFSR #9, but there was a trend of increasing dissolved oxygen as time went by in the datalogger deployment. Dissolved oxygen readings ranged from 1.01 mg/L to 5.73 mg/L. The percentage of the readings that were below the dissolved oxygen criteria of 5 mg/L was 98.36 percent.

At Horse Creek #1 a datalogger was deployed from August 28 to September 1, 2006 (Figures 13 and 14). The dissolved oxygen readings were normally the lowest in the early morning hours. Horse Creek #1 had very low dissolved oxygen readings ranging from 0.19 mg/L to 2.32 mg/L. The lowest dissolved oxygen values occurred during the morning hours and were usually below 1 mg/L. All of the dissolved oxygen readings were below the dissolved oxygen criteria of 5 mg/L.

Figure 5
Dissolved Oxygen and Water Temperature Datalogger Data Collected at NFSR #6 From July 31 to August 3, 2006

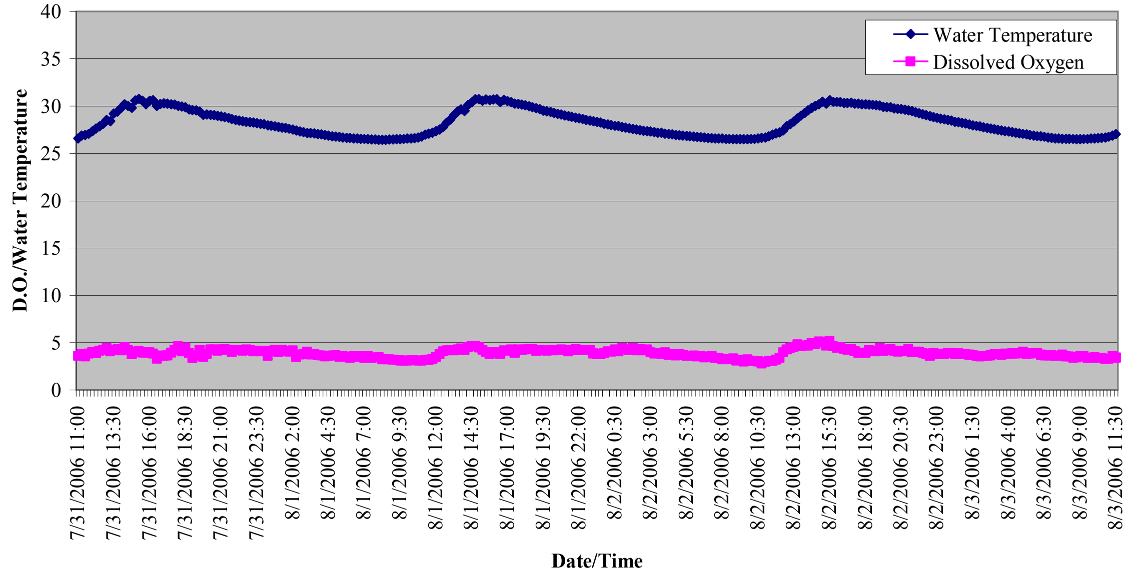


Figure 6
Dissolved Oxygen Datalogger Data Collected at NFSR #6 From July 31 to August 3, 2006

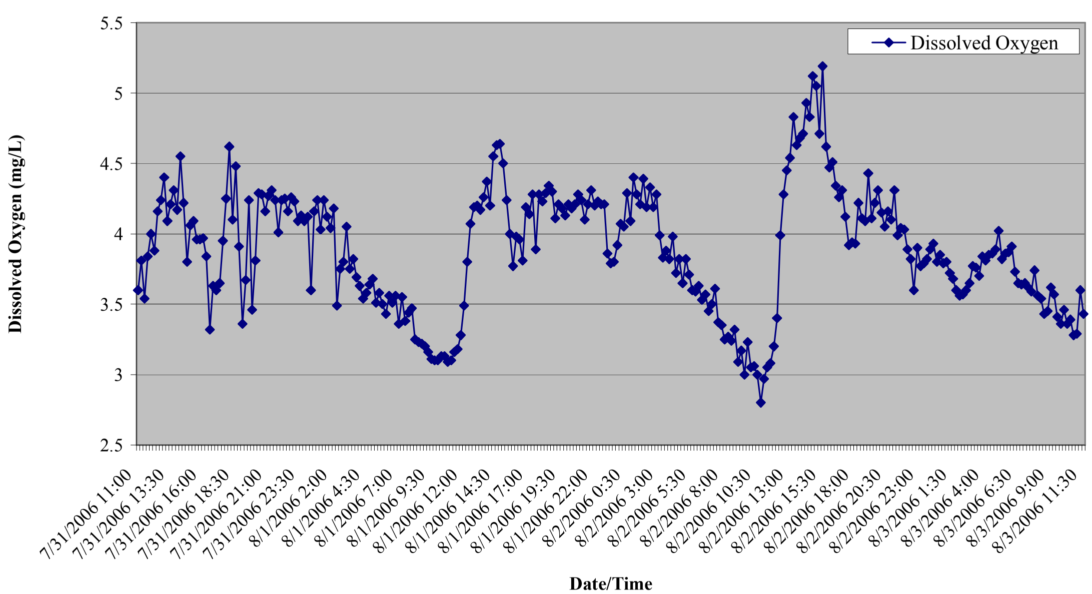


Figure 7
Dissolved Oxygen and Water Temperature Datalogger Data Collected at NFSR #1
From August 7-10, 2006

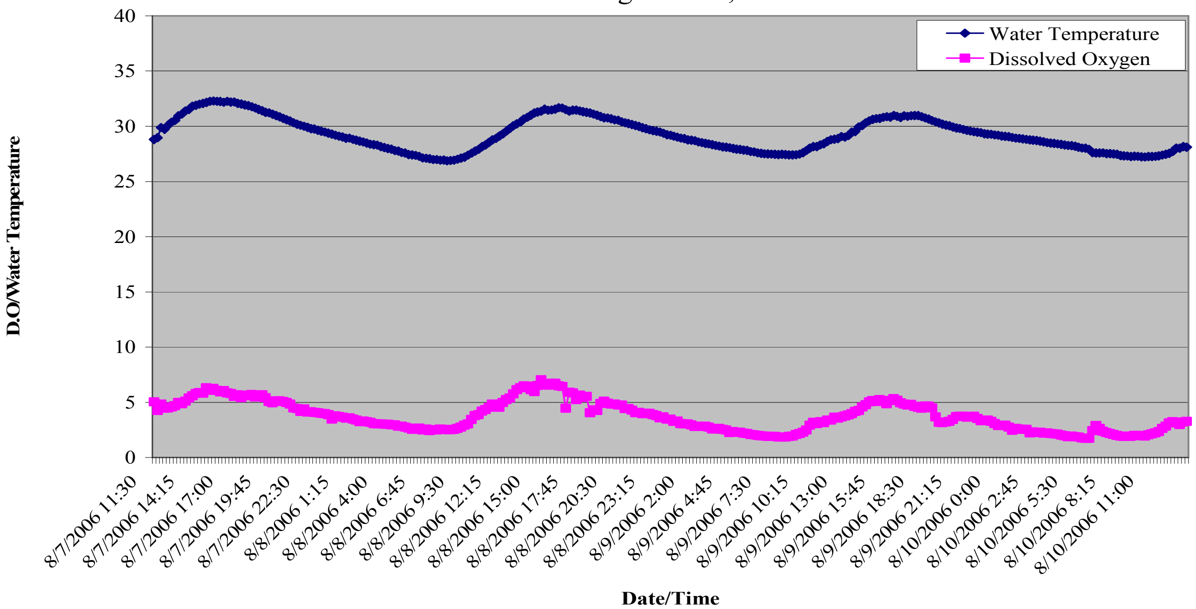


Figure 8
Dissolved Oxygen Datalogger Data Collected at NFSR #1 From August 7-10, 2006

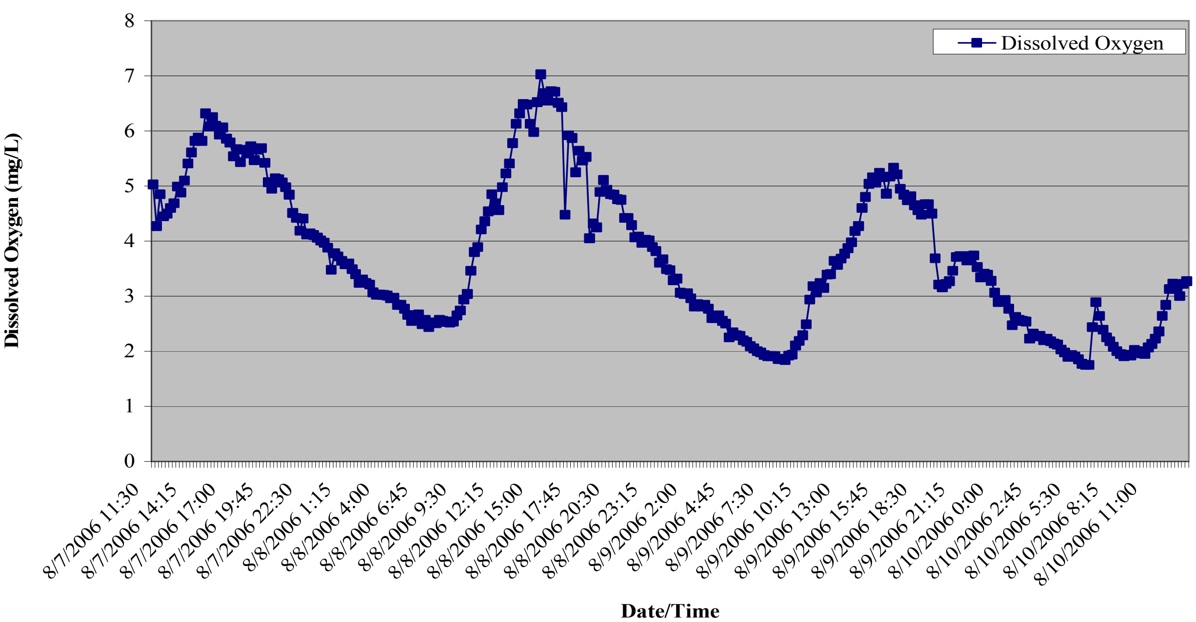


Figure 9
Dissolved Oxygen and Water Temperature Datalogger Data at NFSR #3 From August 7-10, 2006

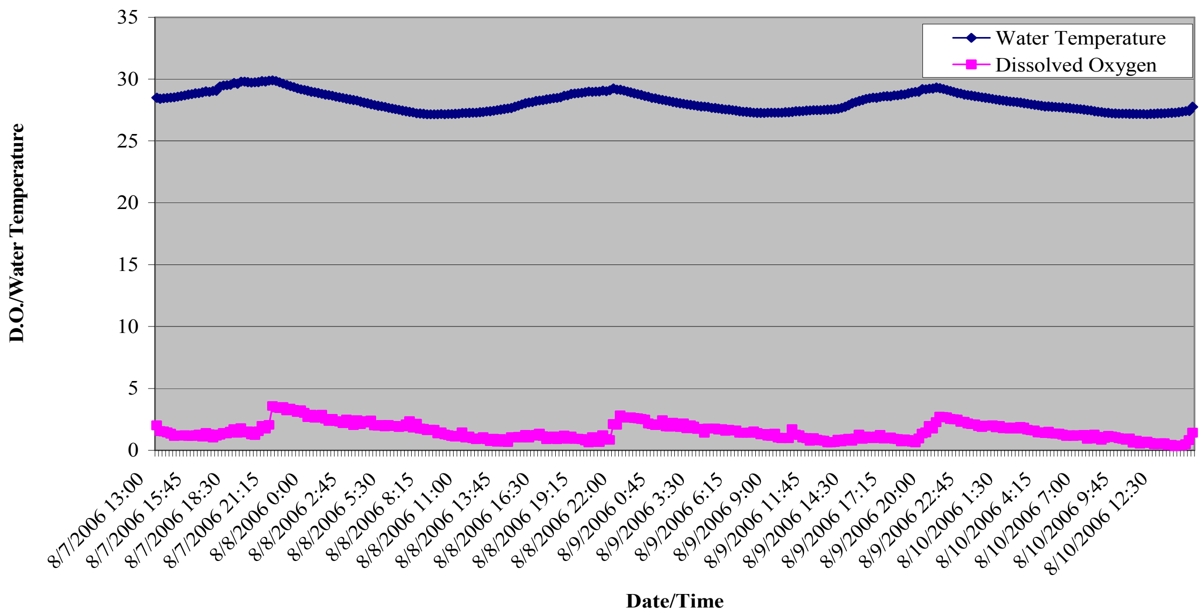


Figure 10
Dissolved Oxygen Datalogger Data at NFSR #3 From August 7-10, 2006

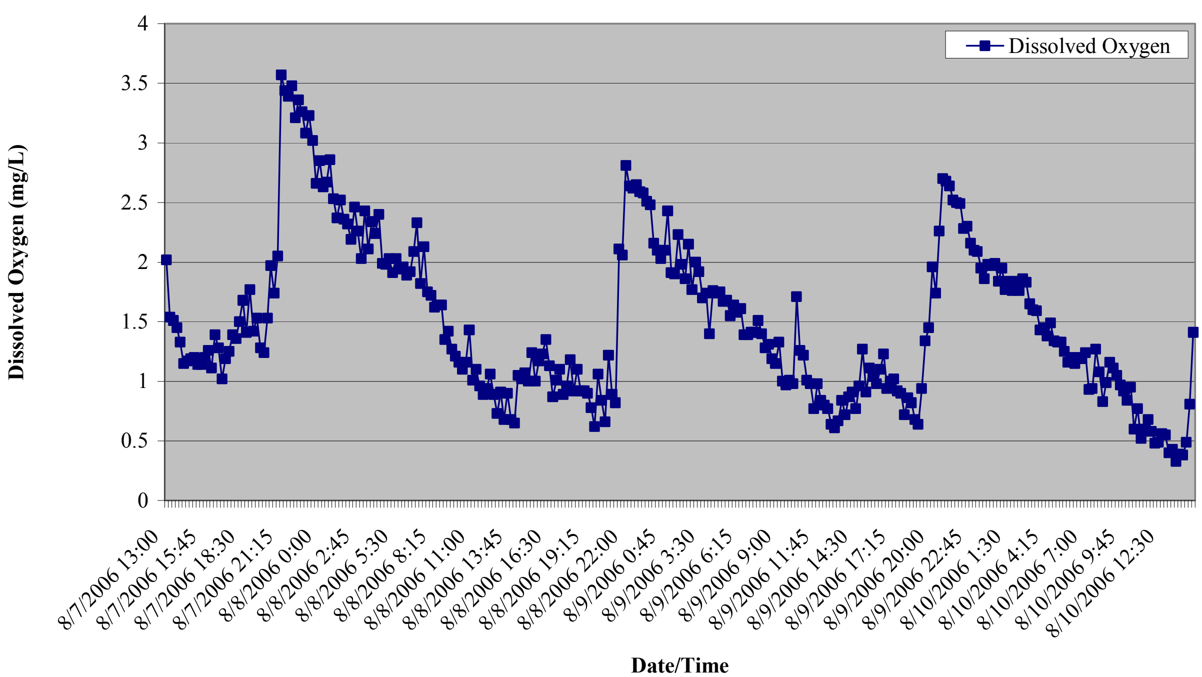


Figure 11
Dissolved Oxygen and Water Temperature Datalogger Data at NFSR #9 From August 28-31, 2006

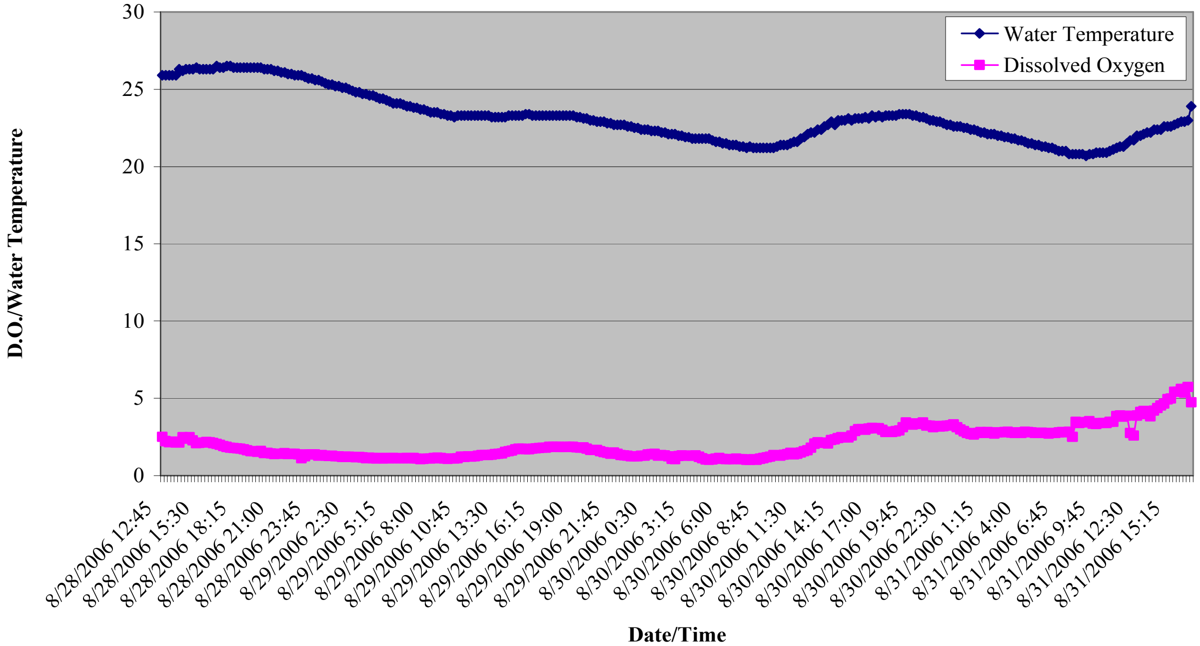


Figure 12
Dissolved Oxygen Datalogger Data at NFSR #9 from August 28-31, 2006

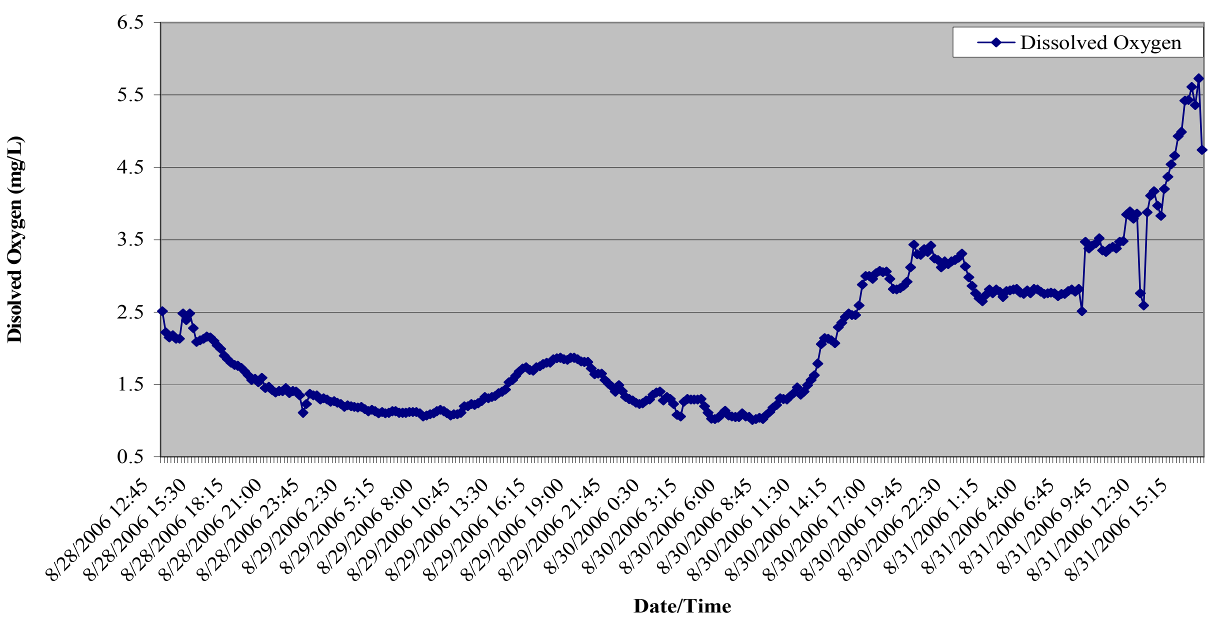


Figure 13
Dissolved Oxygen and Water Temperature Datalogger Data at Horse Creek #1
From August 28 to September 1, 2006

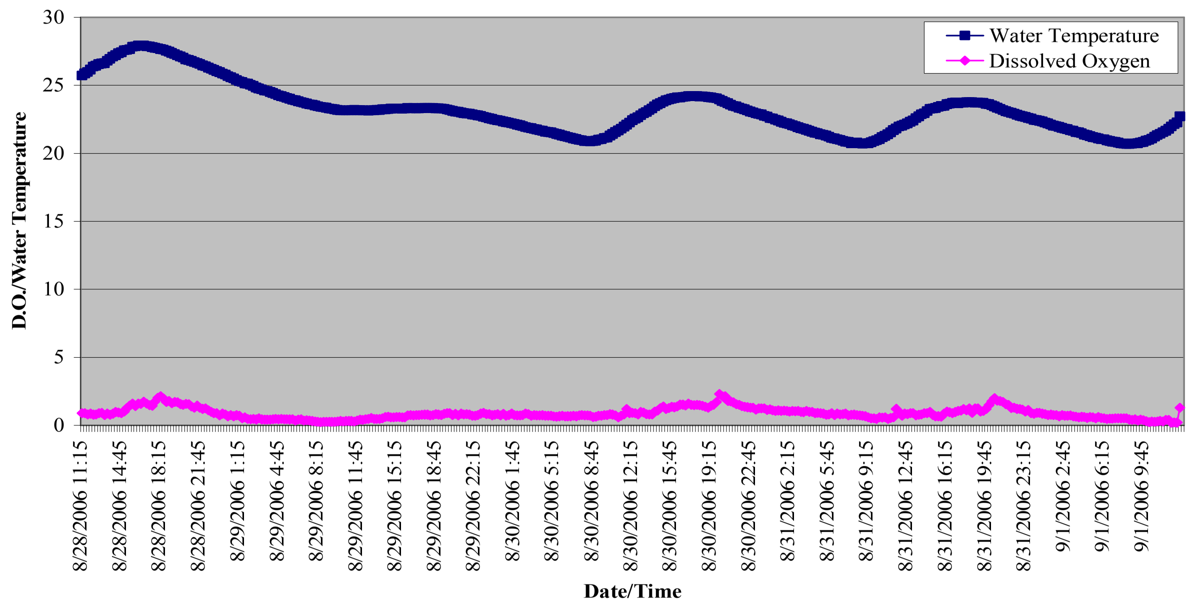
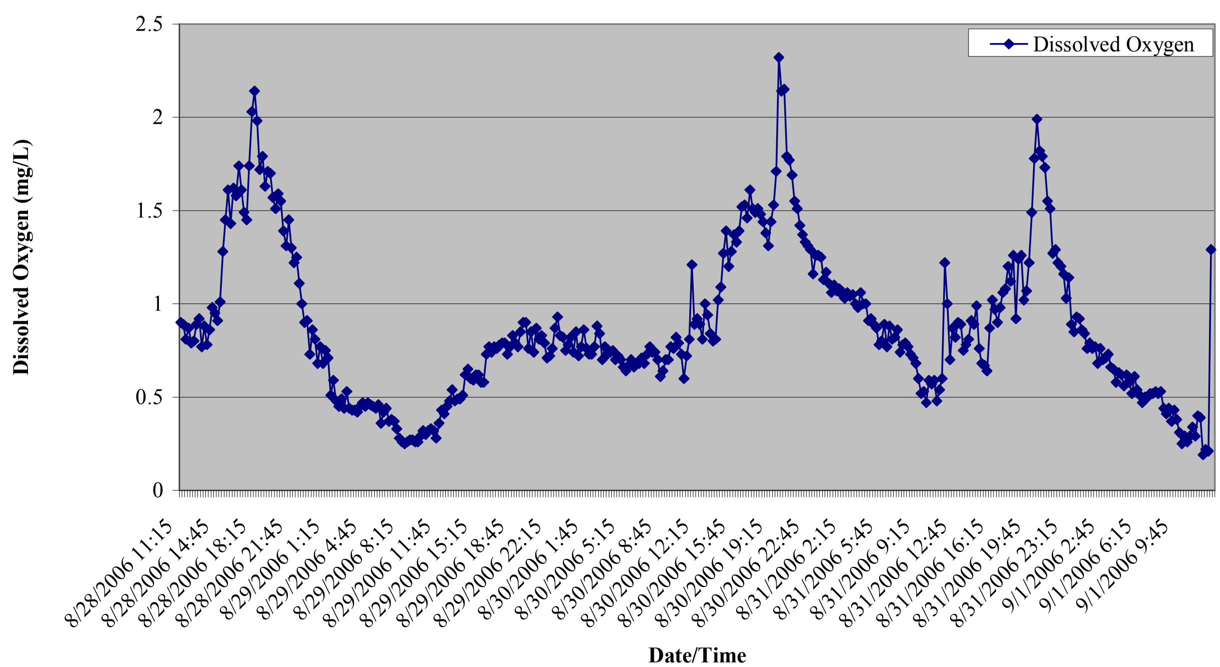


Figure 14
Dissolved Oxygen Datalogger Data at Horse Creek #1 from August 28 to
September 1, 2006



3.2.2 Summer Dissolved Oxygen and Water Temperature Field Measurements

Discrete dissolved oxygen and water temperature field measurements were collected during site visits prior to the fall 2006 macroinvertebrate sampling season (Table 11). The field measurements were collected from early July to early September 2006. The majority of the readings (87 percent) were below the 5 mg/L criteria for dissolved oxygen. Most of the readings that were above 5 mg/L for dissolved oxygen were collected in the afternoon at NFSR #4 and NFSR #5 and most likely were caused by the high planktonic algal biomass that was visible at those stations in late July and early August 2006. The most likely source of the planktonic algae was the Lamar Wastewater Treatment Lagoon.

3.2.3 Fall and Spring Physicochemical Water Samples

Water samples and field measurements were collected during the fall 2006 and spring 2007 macroinvertebrate sampling periods. Physicochemical results are arranged to demonstrate trends of certain variables and may help identify the source of stressors at the NFSR test stations and the biological criteria reference stations. Results are shown in Tables 12 and 13 for quality control, discharge, turbidity, ammonia-N, nitrate + nitrite-N, total nitrogen, total phosphorus, and dissolved oxygen.

3.2.3.1 Quality Control

Duplicate samples were collected at NFSR #4 during the fall 2006 sampling season and NFSR #9 during the spring 2007 sampling season. Results from these duplicates were similar and indicated that sampling, transport, processing, and analyses were consistent as well as precise.

3.2.3.2 Discharge

Water levels were very low during the fall 2006 sampling season. Cedar Creek #1, Horse Creek #1, Little Drywood Creek #2, and NFSR test stations upstream of Lamar were without flow during the sampling period. Discharge at the NFSR test stations ranged from 0 cfs at the stations upstream of Lamar to 1.6 cfs at NFSR #4.

Discharge was much higher during the spring 2007 sampling season. A major rain event occurred in the NFSR watershed on March 20, 2007. This delayed sampling at some stations for two weeks. Discharge at the NFSR test stations ranged from 3.88 cfs at NFSR #10 to 57.1 cfs at NFSR #2.

3.2.3.3 Turbidity

During the fall 2006 sampling season turbidity at NFSR test stations #7 through #9 and Cedar Creek #1 was elevated compared to the other sampling stations and the recommended reference condition values for the level III Central Irregular Plains and Ozark Highland Ecoregions (U.S. EPA 2000a; U.S. EPA 2000b). The U.S. EPA calculated the reference condition for turbidity at 15.5 NTU in the Central Irregular Plains Ecoregion and 1.43 NTU for the Ozark Highlands Ecoregion. Cattle had access to the stream and filamentous algae were very abundant at Cedar Creek #1. At the NFSR stations during the fall 2006 sampling season turbidity ranged from 5.8 NTU at NFSR #1 to 49.4 NTU at NFSR #7 (Table 12).

Table 11
Dissolved Oxygen and Water Temperature Field Measurements Collected During Site Visits
Prior to the Fall 2006 Macroinvertebrate Sampling Season, July-September 2006

Date	Station	Time	Dissolved Oxygen	Water Temperature	Comments
07/06/06	Horse Creek #1	1030	**4.85**	24.6	< 0.5 cfs discharge
07/06/06	NFSR #7	1230	**4.65**	27.1	Just a trickle of flow through riffles
07/06/06	NFSR #6	1442	5.99	29.0	Station has flow (more than a trickle)
07/31/06	NFSR #6	1100	**3.27**	27.7	No flow at station
07/31/06	NFSR #6	1115	**3.48**	27.2	No flow at station
07/31/06	NFSR #4	1215	N/A	N/A	Planktonic algae present
07/31/06	NFSR #10	1315	**2.88**	27.4	Station pooled
07/31/06	NFSR #10	1330	**2.62**	27.8	Station pooled
07/31/06	NFSR #8	1430	**1.10**	27.5	Station pooled
07/31/06	NFSR #8	1445	**1.23**	26.6	Station pooled
07/31/06	Horse Creek #1	1600	**4.04**	31.4	Station pooled
07/31/06	Horse Creek #1	1615	**4.08**	30.5	Station pooled
08/03/06	NFSR #6	1115	**3.32**	27.2	
08/03/06	NFSR #6	1130	**3.30**	27.3	
08/03/06	NFSR #10	1245	**1.97**	26.6	
08/03/06	NFSR #10	1300	**1.94**	27.0	
08/03/06	NFSR #8	1345	**0.80**	25.5	
08/03/06	NFSR #8	1400	**1.20**	25.5	
08/03/06	Horse Creek #1	1530	**4.17**	29.9	
08/03/06	Horse Creek #1	1545	**4.24**	29.2	
08/07/06	NFSR #2	1030	**4.43**	28.3	Station had about 0.25 cfs flow, sunny weather
08/07/06	NFSR #2	1045	**4.86**	28.6	Station had about 0.25 cfs flow, sunny weather
08/07/06	NFSR #1	1130	**4.41**	29.6	Station had < 0.10 cfs flow, sunny weather
08/07/06	NFSR #1	1145	**3.97**	30.2	Station had < 0.10 cfs flow, sunny weather
08/07/06	NFSR #3	1300	**2.28**	29.4	Very little flow at station, sunny weather
08/07/06	NFSR #3	1315	**2.75**	28.8	Very little flow at station, sunny weather
08/07/06	NFSR #4	1355	7.88	29.1	Water turbid and green from algae, sunny weather
08/07/06	NFSR #5	1500	9.28	29.4	Water turbid and green from algae, sunny weather
08/07/06	NFSR #5	1515	9.07	29.3	Water turbid and green from algae, sunny weather
08/07/06	NFSR #6	1540	**4.95**	31.4	Station still had no flow, sunny weather
08/07/06	NFSR #7	1611	6.65	30.0	Station was pooled, sunny weather
08/07/06	NFSR #8	1635	**3.22**	27.8	No noticeable changes from last visit, sunny weather
08/07/06	NFSR #9	1710	**3.70**	29.9	Station pooled, sunny weather
08/07/08	NFSR #10	1745	**1.40**	26.3	Sunny weather
08/10/08	NFSR #10	1005	**3.34**	27.1	
08/10/08	NFSR #9	1030	**2.59**	26.5	
08/10/08	NFSR #8	1055	**2.22**	25.9	Moderate rain during field measurements
08/10/06	NFSR #7	1145	**1.38**	26.3	Cloudy weather
08/10/06	NFSR #6	1123	**3.40**	26.3	Cloudy weather
08/10/06	NFSR #5	1515	5.75	27.4	Planktonic algae present, cloudy weather
08/10/06	NFSR #5	1530	6.80	27.5	Planktonic algae present, cloudy weather
08/10/06	NFSR #4	1222	**3.67**	26.9	Planktonic algae present, cloudy weather
08/10/06	NFSR #3	1430	**1.35**	27.7	Partly cloudy weather
08/10/06	NFSR #3	1445	**1.45**	27.7	Partly cloudy weather
08/10/06	NFSR #2	1402	**4.66**	27.7	Partly cloudy weather

Table 11 Continued
Dissolved Oxygen and Water Temperature Field Measurements Collected During Site Visits Prior Fall 2006 Macroinvertebrate Sampling Season, July-September 2006

Date	Station	Time	Dissolved Oxygen	Water Temperature	Comments
08/10/06	NFSR #1	1315	**3.02**	28.2	Flow <0.10 cfs, partly cloudy weather
08/10/06	NFSR #1	1330	**3.33**	28.2	Flow <0.10 cfs, partly cloudy weather
08/10/06	NFSR #1	1330	**3.33**	28.2	Flow <0.10 cfs, partly cloudy weather
08/28/06	Horse Creek #1	1115	**0.78**	25.8	Trickle of flow caused by recent rains
08/28/06	Horse Creek #1	1130	**0.79**	26.1	Trickle of flow caused by recent rains
08/28/06	NFSR #9	1245	**2.08**	26.6	Station pooled, partly cloudy weather
08/28/06	NFSR #9	1300	**2.34**	27.3	Station pooled, partly cloudy weather
08/29/06	NFSR #4	0800	N/A	N/A	Planktonic algae was no longer present
08/31/06	NFSR #9	1635	**3.14**	24.3	
08/31/06	NFSR #9	1645	**3.47**	24.5	
09/01/06	Horse Creek #1	1245	**1.47**	24.6	Stream still pooled
09/01/06	Horse Creek #1	1300	**1.58**	24.1	Stream still pooled

Compared to the fall 2006 sampling season, turbidity was higher during the spring 2007 sampling season at the downstream NFSR test stations. This most likely was caused by the major rain event that occurred in mid March. Turbidity values at NFSR ranged from 2.49 NTU at NFSR #10 to 32.3 NTU at NFSR #5 during the spring 2007 sampling season. Cedar Creek #1 had a turbidity value of 1.48 NTU which was much lower than the high turbidity value during the fall 2006 sampling season. Neither cattle nor algae were evident at Cedar Creek #1 during the spring 2007 sampling season.

3.2.3.4 Nutrients

3.2.3.4.1 Ammonia-N

Ammonia-N was 2.91 mg/L at NFSR #3 during the fall 2006 sampling season. This value was higher than the chronic criteria of 2.5 mg/L for ammonia-N in the Water Quality Standards for early life stages present classification (MDNR 2005). Ammonia-N values at the other sample stations were well below the criteria in the Water Quality Standards. Ammonia-N was not elevated at any of the sampling stations during the spring 2007 sampling season.

3.2.3.4.2 Nitrate + Nitrite-N

During the fall 2006 sampling season nitrate + nitrite-N was elevated at many NFSR stations compared to the recommended reference condition values for the level III Central Irregular Plains and Ozark Highlands Ecoregions (U.S. EPA 2000a; U.S. EPA 2000b). Nitrate + nitrite-N ranged from below detection limits at NFSR #1 to 0.65 mg/L at NFSR #3 during the fall 2006 sampling season. The U.S. EPA calculated the reference condition for nitrate + nitrite-N at 0.23 mg/L in the Central Irregular Plains Ecoregion and 0.24 mg/L for the Ozark Highlands Ecoregion.

During the spring 2007 sampling season nitrate + nitrite-N was elevated at all of the NFSR test stations compared to values collected during the fall 2006 sampling season. Nitrate + nitrite-N

for the test stations ranged from 0.73 mg/L at NFSR #3 to 2.16 mg/L at NFSR #9a. These values were much higher than the recommended U.S. EPA nitrate + nitrite-N reference condition values and values collected at Missouri biological criteria reference streams.

3.2.3.4.3 Total Nitrogen

During the fall 2006 sampling season total nitrogen was higher than the reference condition values for the level III Central Irregular Plains and Ozark Highlands Ecoregions (U.S. EPA 2000a; U.S. EPA 2000b). Total nitrogen was extremely high and over 5 mg/L at NFSR #3 and Cedar Creek #1. Total nitrogen at the test stations ranged from 0.84 mg/L at NFSR #1 to 5.88 mg/L at NFSR #3. The U.S. EPA calculated the reference condition for total nitrogen at 0.71 mg/L in the Central Irregular Plains Ecoregion and 0.38 mg/L for the Ozark Highlands Ecoregion.

During the spring 2007 sampling season total nitrogen was high at all of the NFSR test stations, ranging from 1.64 mg/L at NFSR #5 to 3.02 mg/L at NFSR #9a. These values were much higher than the recommended U.S. EPA total nitrogen reference condition values and values collected at Missouri biological criteria reference streams.

3.2.3.4.4 Total Phosphorus

During the fall 2006 sampling season total phosphorus was very high at Cedar Creek #1 (2.66 mg/L). The NFSR test stations had slightly elevated levels for total phosphorus compared to the biological reference streams, except Cedar Creek #1, and the recommended U.S. EPA total phosphorus reference condition values for the level III Central Irregular Plains and Ozark Highlands Ecoregions (U.S. EPA 2000a; U.S. EPA 2000b). Total phosphorus at the NFSR test stations ranged from 0.07 mg/L at NFSR #2 and #6 to 0.34 mg/L at NFSR #5. The U.S. EPA calculated the reference condition for total phosphorus at 0.09 mg/L in the Central Irregular Plains Ecoregion and 0.006 mg/L for the Ozark Highlands Ecoregion.

During the spring 2007 sampling season total phosphorus was slightly elevated at most of the NFSR test stations compared to the biological criteria reference streams and the recommended U.S. EPA total phosphorus reference condition values. Total phosphorus at the NFSR test stations ranged from 0.04 mg/L at NFSR #6 to 0.15 mg/L at NFSR#3, #8, and #9b.

3.2.3.4.5 Dissolved Oxygen

During the fall 2006 sampling season discrete dissolved oxygen measurements were below the 5 mg/L water quality standard (MDNR 2005) at four NFSR test stations and LDC #2. Cedar Creek #1 had an extremely high value of 19.9 mg/L which was most likely caused by the large amount of filamentous algae that was present in the stream. Fall 2006 dissolved oxygen at the NFSR test stations ranged from 4.31 mg/L at NFSR #10 to 8.79 mg/L at NFSR #9.

During the spring 2007 sampling season dissolved oxygen was much higher than the 5 mg/L water quality standard at all of the sampling stations. Dissolved oxygen at the NFSR test stations ranged from 6.52 mg/L at NFSR #9 to 8.49 mg/L at NFSR #10.

Table 12
Physicochemical Variables at the NFSR Stressor Study Sampling Stations, Fall 2006

	NFSR #1	NFSR #2	NFSR #3	NFSR #4a	NFSR #4b	NFSR #5	NFSR #6	NFSR #7	NFSR #8	NFSR #9	NFSR #10	Cedar Creek #1	Horse Creek #1	LDC #1	LDC #2
Invertebrate Sample Number	602717	602718	602719	602720	602822	602721	602723	602724	602725	602726	602727	602729	602728	602715	602716
Physicochemical Sample Number	603201	603202	603203	603204	603211	603205	603206	603207	603208	603209	603210	603212	603213	603214	603215
Sample Date	9/28/06	9/27/06	9/27/06	9/27/06	9/27/06	9/26/06	10/4/06	10/3/06	10/3/06	10/3/06	10/3/06	10/2/06	10/2/06	9/25/06	9/25/06
Sample Time	1030	1715	1500	1145	1150	1700	1010	1650	1445	1230	950	1520	1220	1150	1720
Ammonia	0.03*	0.03*	**2.91**	0.06	0.06	0.51	0.03*	0.03*	0.03*	0.03*	0.03*	0.67	0.03*	0.03*	0.03*
Chloride	14.5	27.1	28	12.8	12.7	13.4	10.7	8.54	8.7	9.04	8.67	35.7	6.43	51.2	6.38
Dissolved Oxygen	6.05	5.24	**4.43**	5.58	5.58	**3.78**	**4.34**	9.69	6.62	8.79	**4.31**	**19.9**	6.14	6.42	3.64
Discharge (cfs)	0.51	1.23	1.13	1.6	1.6	1.5	0	0	0	0	0	0	0	0.1	0
pH (Units)	7.8	7.7	7.8	7.8	7.8	7.8	7.6	8.7	7.8	7.8	7.5	9	7.9	7.8	7.9
Conductivity (umhos/cm)	274	366	392	229	229	244	232	162	186	192	261	464	234	456	292
Temperature (C^0)	14.5	19	18	17.5	17.5	19	21	22	23.5	22	19.5	25	19	17	17
Turbidity (NTU)	5.8	10.3	9.82	8.94	9.68	**20.9**	13.4	**49.4**	**42.4**	**39.4**	**15.7**	**62.6**	5.4	4.84	6.51
Nitrate + Nitrite	0.01**	0.06	**0.65**	**0.29**	**0.29**	**0.51**	0.01*	**0.44**	**0.33**	0.12	0.01*	0.13	0.04**	0.02**	0.01*
Total Nitrogen	**0.84**	**1.38**	**5.88**	**1.25**	**1.28**	**2.12**	**0.81**	**1.14**	**1.03**	**1.22**	**0.91**	**5.67**	**0.68**	**0.56**	**0.79**
Total Phosphorus	0.08	0.07	**0.12**	**0.15**	**0.14**	**0.34**	0.07	**0.17**	**0.24**	**0.2**	**0.11**	**2.66**	0.03**	0.03**	0.05**

*Below detectable limits
**Estimated value, detected below Practical Quantitation Limit
Units mg/L unless otherwise noted. Values in bold are elevated compared to U.S. EPA recommended reference condition values

Table 13
Physicochemical Variables at the NFSR Stressor Study Sampling Stations, Spring 2007

	NFSR #1	NFSR #2	NFSR #3	NFSR #5	NFSR #6	NFSR #7	NFSR #8	NFSR #9a	NFSR #9b	NFSR #10	Cedar Creek #1	Horse Creek #1	LDC #1
Invertebrate Sample Number	0703244	0703253	0703252	0703245	0703246	0703251	0703249	0703247	0703248	0703243	0703242	0703241	0703250
Physicochemical Sample Number	0704041	0704042	0704043	0704045	0704046	0704047	0704048	0704049	0704051	0704050	0704052	0704053	0704054
Sample Date	3/20/07	4/5/07	4/4/07	3/20/07	3/20/07	4/4/07	4/3/07	4/3/07	4/3/07	3/19/07	3/19/07	3/19/07	4/4/07
Sample Time	950	915	1545	1230	1445	1210	1615	1201	1207	1545	1330	1030	945
Ammonia	0.08	0.03*	0.03*	0.14	0.03*	0.03*	0.03*	0.03*	0.03	0.03*	0.03*	0.03*	0.03*
Chloride	25.4	18.7	19.6	28.2	23.4	20.9	21.2	21.8	21.8	25.4	15.6	15.2	13
Dissolved Oxygen	6.89	8.29	8.25	7.32	7.63	8.4	8.29	6.52	6.52	8.49	10.7	11.6	8.04
Discharge (cfs)	47.5	57.1	43	15.2	9.43	20.4	22.4	20	20	3.88	7.44	12.1	35.4
pH (Units)	7.5	7.4	7.6	7.5	7.7	7.6	7.8	7.7	7.7	7.6	7.9	8.4	7.8
Conductivity (umhos/cm)	334	364	349	334	314	388	345	343	343	302	321	268	306
Temperature (C^0)	12.5	12.5	17	13	13	15.5	19.5	18	18	13	12	13	13.5
Turbidity (NTU)	**26.9**	15.2	**23.3**	**32.3**	8.74	**16.3**	9.89	8.38	8.38	2.49	1.48	4.9	11.4
Nitrate + Nitrite	**1.32**	**1.74**	**1.2**	**0.73**	**1.01**	**1.8**	**1.97**	**2.16**	**2.14**	**1.7**	**0.31**	0.18	**0.41**
Total Nitrogen	**2.08**	**2.58**	**2.07**	**1.64**	**1.69**	**2.66**	**2.84**	**3.02**	**3.01**	**2.23**	**0.59**	**0.6**	**1.12**
Total Phosphorus	**0.1**	**0.11**	**0.15**	**0.13**	0.04**	**0.12**	**0.15**	**0.14**	**0.15**	0.02**	0.03**	0.02**	0.09

*Below detectable limits
**Estimated value, detected below Practical Quantitation Limit
Units mg/L unless otherwise noted. Values in bold are elevated compared to U.S. EPA recommended reference condition values

3.3 Benthic Sediment

Benthic sediment values for total sediment, silt, and sand for each sampling station are shown in Figure 15 and Table 14. The statistical analyses conducted to determine significant differences between sampling stations can be found in Appendix E.

3.3.1 Total Sediment

Except for LDC #2, the quantity of total benthic sediment (sand + silt) was significantly higher at NFSR #5 (One-way ANOVA, square root transformed, $P < 0.05$). No other NFSR test station had significantly more total benthic sediment than the biological criteria reference stations. The NFSR #10 test station had the most benthic sediment after NFSR #5 and had significantly more benthic sediment than NFSR #1, NFSR #7, NFSR #9, and Cedar Creek #1 (One-way ANOVA, square root transformed, $P < 0.05$). North Fork of the Spring River test stations #1 and #7 had the lowest amounts of benthic sediment. North Fork of the Spring River #1 had significantly lower amounts of benthic sediment than the two LDC sampling stations and all of the other test stations except NFSR #2, NFSR #7, and NFSR #9 (One-way ANOVA, square root transformed, $P < 0.05$). Test station #7 had significantly lower amounts of benthic sediment than Horse Creek #1, the two LDC sampling stations, and all of the test stations except NFSR #1 and NFSR #9 (One-way ANOVA, square root transformed, $P < 0.05$). The other test stations had total sediment means ranging from 64,584 mm^3 at NFSR #9 to 100,011 mm^3 at NFSR #8 and the sediment values at these stations were not significantly different.

3.3.2 Silt

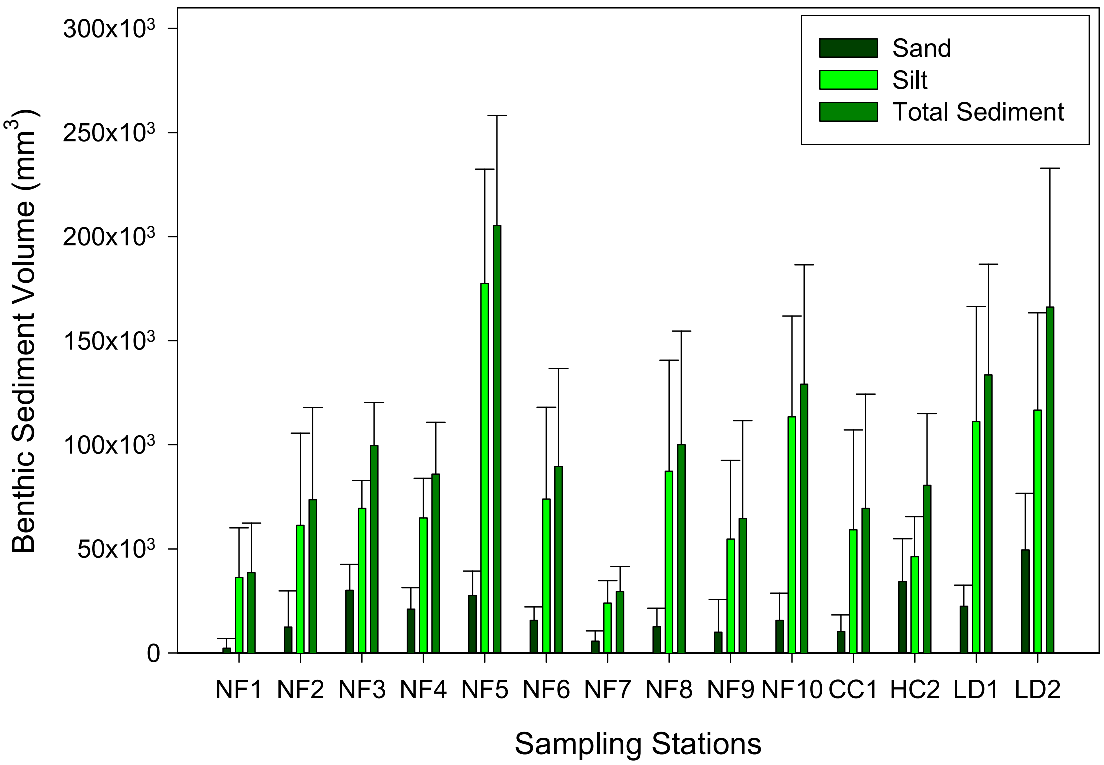
The benthic sediment samples contained much more silt than sand. The average silt percentage in most samples was greater than 70 percent, except Horse Creek #1 with 58.44 percent. The estimated silt volume in the benthic sediment samples showed trends that were similar to the total sediment volume at most sampling stations. North Fork of the Spring River test station #5 had a significantly higher amount of silt in the sediment samples than all of the other sampling stations (One-way ANOVA, square root transformed, $P < 0.05$). Test station #10 had the second highest amount of silt at the test stations and was significantly higher than Cedar Creek #1, Horse Creek #1, NFSR #1, NFSR #2, NFSR #7, and NFSR #9 (One-way ANOVA, square root transformed, $P < 0.05$). Test station #7 had the lowest amount of silt in the sediment samples and was significantly lower than the other NFSR test stations except NFSR #1 and NFSR #9 (One-way ANOVA, square root transformed, $P < 0.05$).

3.3.3 Sand

Sand made up less than 20 percent of benthic sediment samples except at NFSR #3, NFSR #4, Horse Creek #1, and LDC #1. Sand was highest by volume at LDC #2 and was significantly higher than the other sampling stations (Kruskal-Wallis One-way ANOVA on Ranks, $P < 0.05$). Horse Creek #1 had a significantly higher amount of sand than all of the sampling stations except NFSR #3, NFSR #5, and LDC #2. The highest sand volume at test stations was found at NFSR #3 and NFSR #5. Glide/pool test stations #3 and #5 had a significantly higher amount of sand than two of the biological criteria reference stations, the GP station at LDC #1 and the RP station at Cedar Creek #1 (Kruskal-Wallis One-way ANOVA on Ranks, $P < 0.05$). Test stations at NFSR #4, NFSR #6, and NFSR #10 had significantly higher amounts of sand than Cedar Creek

#1 (Kruskal-Wallis One-way ANOVA on Ranks, $P < 0.05$). Transitional test stations NFSR #1, NFSR #7, and NFSR #9 had the lowest levels of sand and were significantly lower than all of the biological criteria reference stations (Kruskal-Wallis One-way ANOVA on Ranks, $P < 0.05$). Test station NFSR #2 also had low levels of sand compared to most of the other stations and was significantly lower than all of the biological criteria reference stations except Cedar Creek #1 (Kruskal-Wallis One-way ANOVA on Ranks, $P < 0.05$).

Figure 15
Benthic Sediment Mean and Standard Deviation Values at North Fork of the Spring River Stressor Study Sampling Stations



NF = North Fork of the Spring River
CC = Cedar Creek
HC = Horse Creek
LD = Little Drywood Creek

3.4 Sinuosity

Sinuosity at the NFSR test stations had a mean of 1.40 and ranged from 1.08 at NFSR #9 to 2.08 at NFSR #3 (Table 15). Test stations #7 and #9 were the only two stations that had sinuosity values close to 1.0, which indicates a straight stream channel. The two Little Drywood Creek sampling stations had sinuosity values over 2.0, which was much more sinuous than all NFSR test stations, except station #3. Sinuosity at both Cedar and Horse creeks was 1.48.

3.5 Channel Measurements

Table 16 shows values for the metrics calculated from channel measurements. The statistical analyses conducted to determine significant differences between sampling stations can be found in Appendix F.

Watershed size ranged from 47 square miles at NFSR #10 to 394 square miles at NFSR #1 (Table 14). The upper NFSR stations, which were located in the Ozark Highlands Ecoregion (Figure 1), had similar watershed sizes to the two reference streams in a transitional area of the Ozark/Osage EDU. The two downstream NFSR stations, which were located in the Ozark Highlands Ecoregion, were much larger than the two reference streams in the Ozark/Osage EDU. North Fork of the Spring River stations #3-#6 in the Central Irregular Plains Ecoregion had much larger watersheds than the two Little Drywood Creek stations in the Central Plains/Osage/South Grand EDU.

Except for Cedar Creek #1, NFSR #1 had a much wider channel than the other sampling stations. Channel width and wetted width were significantly wider at NFSR #1 than the other sampling stations (Kruskal-Wallis ANOVA on Ranks, $P < 0.05$). North Fork of the Spring River stations #2 and #7-#9, which were located in or near the Ozark Highlands Ecoregion, had similar channel widths to Horse Creek #1. Wetted width at the transitional NFSR test stations #2, #8, and #9 were significantly higher than Horse Creek #1, but not Cedar Creek #1 (Kruskal-Wallis ANOVA on Ranks, $P < 0.05$). Transitional NFSR test station #7 had wetted width that was significantly lower than Cedar Creek #1 but higher than Horse Creek #1 (Kruskal-Wallis ANOVA on Ranks, $P < 0.05$). North Fork of the Spring River test stations #3-#6, which were GP in nature, had similar channel widths compared to the channel widths of the most downstream LDC station. Glide/pool stations #3-#5 had significantly higher wetted widths than the Little Drywood Creek GP stations (Kruskal-Wallis ANOVA on Ranks, $P < 0.05$). Test station #6, which had very low water levels, had a much smaller wetted width than most of the other NFSR test stations, but was similar to the LDC stations. Test station #6 had a much higher channel width/wetted width ratio value than the other sampling stations. Glide/pool NFSR stations #3-#5 had the lowest channel width/wetted width ratio values. The other NFSR test stations which were transitional in nature had similar channel width/wetted width values compared to Cedar and Horse creeks. The channel width to wetted width ratio results at NFSR stations #3-#6 indicate that a much higher proportion of the channel width was filled by water at test station #6 than the other NFSR stations and a much higher proportion of the channel width was filled by water at test stations #3-#5.

Table 14
Benthic Sediment Estimates (mm^3) Using the Benthic Sediment Sampler, North Fork of the Spring River Stressor Study
Summer 2006

Measurement	**Sand**	**Silt**	**Total Sediment**
Test Stations			
NFSR #1	2299 ± 4590	36159 ± 23969	38457 ± 23952
NFSR #2	12436 ± 17330	61240 ± 44251	73676 ± 44190
NFSR #3	**30202 ± 12389**	69391 ± 13475	99593 ± 20738
NFSR #4	21006 ± 10374	64898 ± 18987	85903 ± 24866
NFSR #5	**27694 ± 11546**	**177659 ± 54801**	**205352 ± 52837**
NFSR #6	15676 ± 6404	73990 ± 44019	89665 ± 47020
NFSR #7	5643 ± 4931	23932 ± 10753	29575 ± 11855
NFSR #8	12645 ± 8914	87366 ± 53210	100011 ± 54606
NFSR #9	9928 ± 15728	54656 ± 37860	64584 ± 46930
NFSR #10	15676 ± 12941	**113492 ± 48372**	129168 ± 57289
Reference/Control Stations			
Ozark/Osage EDU			
Cedar Creek #1	10242 ± 7971	59150 ± 47967	69391 ± 54998
Horse Creek #1	34278 ± 20578	46191 ± 19224	80469 ± 34421
Central Plains/Osage/ South Grand EDU			
Little Drywood Creek #1	22469 ± 10159	111089 ± 55455	133557 ± 53291
Little Drywood Creek #2	49431 ± 27278	116732 ± 46671	166163 ± 66696

Values are listed in the table as the mean ± SD. Test station values highlighted in bold are significantly higher than at least 1 biological criteria reference station.

Table 15
Stream Channel Measurements Calculated for the North Fork of the Spring River Stressor Study, Summer 2006

Measurement	Drainage Area (Miles^2)	Sinuosity	Channel Width (Feet)	Wetted Width (Feet)	Ratio of Channel Width to Wetted Width	Water Depth (Feet)	Ratio of Wetted Width to Water Depth	Maximum Depth (Feet)
Test Stations								
NFSR #1	394	1.35	88.9 ± 14.9	54.9 ± 19.8	2.1 ± 1.6	1.0 ± 0.5	66.0 ± 37.1	2.2
NFSR #2	358	1.53	72.7 ± 5.2	41.0 ± 11.5	1.9 ± 0.7	1.5 ± 1.1	38.4 ± 18.9	4.5
NFSR #3	295	2.08	51.9 ± 7.3	33.9 ± 5.0	1.6 ± 0.3	2.11 ± 0.7	17.8 ± 7.9	3.7
NFSR #4	230	1.37	46.8 ± 5.1	37.1 ± 3.5	1.3 ± 0.2	2.2 ± 0.8	17.1 ± 3.9	3.7
NFSR #5	181	1.64	47.1 ± 3.0	35.9 ± 4.5	1.3 ± 0.2	2.1 ± 0.7	18.7 ± 5.6	3.3
NFSR #6	167	1.34	51.9 ± 11.9	16.2 ± 5.9	3.6 ± 1.6	1.2 ± 0.8	16.1 ± 8.1	3.8
NFSR #7	115	1.09	63.4 ± 5.8	28.3 ± 13.6	2.8 ± 1.5	1.1 ± 0.6	28.7 ± 10.4	2.6
NFSR #8	102	1.24	72.0 ± 10.6	45.0 ± 21.4	2.2 ± 1.5	1.5 ± 1.0	30.3 ± 7.6	4.4
NFSR #9	83	1.08	65.4 ± 13.0	36.9 ± 20.0	2.5 ± 1.7	1.1 ± 0.6	32.7 ± 10.9	2.5
NFSR #10	47	1.29	52.0 ± 10.6	29.0 ± 12.3	2.1 ± 1.1	1.1 ± 0.6	30.6 ± 18.7	2.6
Reference/Control Stations								
Ozark/Osage EDU								
Cedar Creek #1	69	1.48	94.3 ± 36.2	35.1 ±12.1	3.3 ± 2.3	1.0 ± 0.4	38.9 ± 16.9	2.2
Horse Creek #1	191	1.48	64.5 ± 13.0	26.4 ± 12.7	2.9 ± 1.4	1.0 ± 0.5	29.0 ± 15.1	2.1
Central Plains/Osage/ South Grand EDU								
L. Drywood Creek #1	123	2.15	48.1 ± 13.3	21.5 ± 5.1	2.5 ± 1.4	1.1 ± 0.5	22.7 ± 8.8	2.2
L. Drywood Creek #2	46	2.32	37.1 ± 8.1	16.0 ± 4.9	2.6 ± 1.4	0.9 ± 0.3	19.6 ± 5.8	1.8

Values are listed in the table as the mean ± SD for the measurements that were collected at multiple transects located within the sampling stations.

Water depth was much higher at NFSR #3-#5 than the other sampling stations (Kruskal-Wallis ANOVA on Ranks, $P < 0.05$). Test stations #2 and #8 had part of the sampling reaches made up of deep large pools and these stations had a high standard deviation of water depth. The other test stations had water depths that were similar to the water depths found at the biological criteria reference streams. The maximum depth results show that many of the NFSR test stations had sections of the sampling reach with high water depths. The wetted width to water depth ratio was much higher at NFSR #1 than any of the other sampling stations (One-way ANOVA, Log_{10} transformed, $P < 0.05$). The lowest wetted width to water depth ratio values occurred at NFSR glide/pool stations #3-#6 and was similar to the values at the LDC sampling stations (One-way ANOVA, Log_{10} transformed, $P < 0.05$). The other stations (#2, #7-#10) which were transitional stations had wetted width to water depth ratio values that were similar to Cedar and Horse creeks (One-way ANOVA, Log_{10} transformed, $P < 0.05$).

The results of the channel measurements indicate that NFSR #1 had different channel characteristics than the other NFSR test stations. It had wider channel with lower water depths and standard deviation of the water depth than the other NFSR test stations. Glide/pool NFSR test stations #3-#5 were similar to the LDC stations for many channel metrics, but had higher wetted widths and water depths. The upper NFSR transitional stations were similar to Cedar and Horse creeks for many channel metrics, but had higher maximum depths and slightly higher standard deviation of water depth.

3.6 MDC RAM Data

Fish, stream habitat measurements, and water quality were collected at four stations within or just downstream of the 303(d) listed reach of the NFSR during the summer of 2006 (Figure 1). Two stations were sampled on June 26-27, 2006 and the other two stations were sampled on August 17, 2006. All four stations were located in the transitional part of the NFSR that had characteristics of both the plains and Ozark ecoregions. A fish index of biotic integrity (**IBI**) was used to assess the sampling stations based on the structure and composition of the fish community.

3.6.1 Fish Community Biological Assessment

The fish community in NFSR (Table 16) was transitional in nature with species that are commonly found in plains streams like the red shiner (*Cyprinella lutrentis*) and other species like the golden redhorse (*Moxostoma erythrurum*) that are commonly found in Ozark streams. The NFSR also had fish species like the Arkansas darter (*Etheostoma cragini*) and the channel darter (*Percina copelandi*) that in Missouri are only found in the Ozark/Neosho EDU. Biological criteria using a Missouri fish IBI (**MIBI**) was recently developed for the Ozark ecoregion and was used to assess the sampling stations since part of the NFSR fish community was made up of species that are only commonly found in the Ozarks (Doisy et. al. 2008). The draft fish biological criteria for the Ozark ecoregion are made up of 9 biological metrics as shown in Table 17. The maximum score for the MIBI is 45 with each metric receiving a score of 1, 3, or 5. Impairment of sampling stations is based on a three-level classification of stream condition. The three levels of classification are: no impairment (MIBI scores >36); impaired (MIBI scores 29-36); and highly impaired (MIBI scores <29).

Table 16
Counts and Percent Composition of Fish Species Found at the NFSR MDC RAM Sampling Stations

	Site Number 207-1327	Site Number 207-1171	Site Number 207-1601	Site Number 207-1828
Longnose Gar	2 (0.2)	1 (0.1)	1 (0.1)	1 (0.2)
Gizzard Shad	2 (0.2)	-	15 (1.4)	**47 (7.9)**
Central Stoneroller	13 (1.3)	15 (2.2)	**83 (7.7)**	3 (0.5)
Red Shiner	53 (5.5)	-	40 (3.7)	10 (1.7)
Common Carp	1 (0.1)	-	-	-
Redfin Shiner	56 (5.8)	24 (3.5)	10 (0.9)	26 (4.4)
Golden Shiner	-	-	1 (0.1)	-
Bigeye Shiner	**212 (21.9)**	19 (2.8)	9 (0.8)	-
Rosyface Shiner	-	-	-	3 (0.5)
Suckermouth Minnow	-	-	21 (2.0)	13 (2.2)
Bluntnose Minnow	**77 (7.9)**	25 (3.7)	44 (4.1)	**109 (18.3)**
Bullhead Minnow	2 (0.2)	-	-	-
Northern Hogsucker	-	-	2 (0.2)	4 (0.7)
Smallmouth Buffalo	-	-	1 (0.1)	32 (5.4)
Spotted Sucker	33 (3.4)	**37 (5.4)**	1 (0.1)	6 (1.0)
Black Redhorse	-	-	8 (0.7)	5 (0.8)
Golden Redhorse	4 (0.4)	4 (0.6)	40 (3.7)	**76 (12.8)**
Shorthead Redhorse	-	-	9 (0.8)	-
Black Bullhead	-	1 (0.1)	-	-
Yellow Bullhead	-	10 (1.5)	4 (0.4)	1 (0.2)
Channel Catfish	-	-	1 (0.1)	2 (0.3)
Slender Madtom	-	-	5 (0.5)	2 (0.3)
Flathead Catfish	-	1 (0.1)	1 (0.1)	5 (0.8)
Blackstripe Topminnow	23 (2.4)	24 (3.5)	-	-
Western Mosquitofish	6 (0.6)	11 (1.6)	11 (1.0)	-
Brook Silversides	26 (2.7)	**83 (12.1)**	4 (0.4)	**95 (16.0)**
Green Sunfish	**94 (9.7)**	**134 (19.6)**	28 (2.6)	10 (1.7)
Orangespotted Sunfish	**91 (9.4)**	26 (3.8)	**119 (11.1)**	20 (3.4)
Bluegill	**118 (12.2)**	**129 (18.9)**	**230 (21.5)**	8 (1.3)
Longear Sunfish	55 (5.7)	**63 (9.2)**	**235 (21.9)**	**84 (14.1)**
Spotted Bass	-	-	20 (1.9)	1 (0.2)
Largemouth Bass	31 (3.2)	24 (3.5)	16 (1.5)	21 (3.5)
White Crappie	-	2 (0.3)	-	-
Greenside Darter	-	-	1 (0.1)	1 (0.2)
Arkansas Darter	11 (1.1)	3 (0.4)	2 (0.2)	-
Fantail Darter	3 (0.3)	1 (0.1)	**47 (4.4)**	-
Johnny Darter	4 (0.4)	2 (0.3)	-	-
Orangethroat Darter	43 (4.4)	13 (1.9)	42 (3.9)	5 (0.8)

Table 16 Continued
Counts and Percent Composition of Fish Species Found at the NFSR MDC RAM Sampling Stations

	Site Number 207-1327	Site Number 207-1171	Site Number 207-1601	Site Number 207-1828
Banded Darter	-	-	1 (0.1)	-
Logperch	1 (0.1)	9 (1.3)	1 (0.1)	5 (0.8)
Channel Darter	-	-	15 (1.4)	-
Slenderhead Darter	-	-	2 (0.2)	-
Green Sunfish/Bluegill Hybrid	7	19 (2.8)	-	-
Green Sunfish/Longear Sunfish Hybrid	-	4 (0.6)	2 (0.2)	-
Species Diversity	25	26	36	27

Percent composition values are shown in parentheses.
Values in bold are the five most abundant species for each sample.

Table 17
Missouri Fish Biological Criteria Calculated for the Ozark Ecoregion

Metric	**Score = 1**	**Score = 3**	**Score = 5**
# of Native Individuals	<216	216 – 431	>431
# of Native Darter Species	<2	2	>2
# of Native Benthic Species	<3	3 – 5	>5
# of Native Water Column Species	<4	4 – 7	>7
# of Native Minnow Species	<3	3 – 5	>5
# of All Native Lithophilic Species	<7	7 – 13	>13
% of Native Insectivore Cyprinid Individuals	<0.067	0.067 – 0.134	>0.134
% of Native Sunfish Individuals	<0.013	0.013 – 0.026	>0.026
% of the Three Dominant Species	>0.815	0.64 – 0.815	<0.64

The MIBI scores at the four sampling stations ranged from 39 to 45 which indicated that the stations were not impaired based on the fish community (Table 18). The station located upstream of NFSR #9 (207-1327) scored a 45, the station just downstream of NFSR #9 (207-1171) scored a 39, the station just downstream of NFSR #2 (207-1601) scored a 41, and the station just downstream of the confluence of Dry Fork Creek (207-1828) scored a 41. The percent of native insectivore cyprinid individuals was the only metric with poor results at most sampling stations. All of the stations except 207-1327 scored a 1 for this metric. Sampling station 207-1327 scored a 5 for this metric because of the high abundance of the bigeye shiner (*Notropis boops*).

The species diversity at the NFSR fish sampling stations was high compared to the biological criteria reference streams in the Ozark ecoregion (Table 16). Species diversity ranged from 25 to 36 at the NFSR sampling stations compared to the mean value of 22 at the biological criteria reference streams in the Ozark ecoregion (Doisy et al. 2008). Previous studies on the effect of sedimentation of fishes have shown that sedimentation primarily impacts food supply or feeding

and reproduction (Berkman and Rabeni 1987). Metrics that were included in the MIBI that might indicate sediment impairment (e.g. number of native darter species, number of native benthic species, and the number of all native lithophilic species) did not indicate sediment impairment at the sampling stations. The values at the NFSR stations (Table 18) were close to the reference mean values at the biological criteria reference streams in the Ozark ecoregion for the number of native darter species (3.6), the number of benthic species (7.3), and higher for the number of all native lithophilic species (16.8) (Doisy et. al. 2008).

Table 18
Missouri Fish IBI (MIBI) Values and Scores, Using Biological Criteria Calculated From the Reference Streams in the Ozark Ecoregion

Sampling Station	**207-1327**	**207-1171**	**207-1601**	**207-1828**
Sample Date	06/26/06	08/17/06	06/27/06	08/17/06
Metric				
# of Native Individuals	969 (5)	684 (5)	1072 (5)	595 (5)
# of Native Darter Species	5 (5)	5 (5)	8 (5)	3 (5)
# of Native Benthic Species	7 (5)	7 (5)	15 (5)	9 (5)
# of Native Water Column Species	11 (5)	11 (5)	11 (5)	10 (5)
# of Native Minnow Species	6 (5)	**4 (3)**	7 (5)	6 (5)
# of All Native Lithophilic Species	19 (5)	20 (5)	28 (5)	23 (5)
% of Native Insectivore Cyprinid Individuals	0.28 (5)	**0.06 (1)**	**0.02 (1)**	**0.05 (1)**
% of Native Sunfish Individuals	0.28 (5)	0.36 (5)	0.37 (5)	0.23 (5)
% of the Three Dominant Species	0.44 (5)	0.51 (5)	0.54 (5)	0.48 (5)
Total MIBI Score	45	39	41	41

Metric scores are shown in parentheses.

Prior to the development of the Missouri IBI a U.S. EPA Environmental Monitoring and Assessment Program (**EMAP**) IBI was used by MDC (Table 19). Metrics included in the old fish IBI that might indicate impairment caused by low dissolved oxygen or sedimentation were proportion of tolerant individuals, proportion of insectivore/invertivore individuals, and proportion of ominivore/herbivore individuals. The scores for the proportion of insectivore/invertivore individuals metric were low for the upstream stations (201-1171 and 207-1327) and the other metrics were low at all of the sampling stations. The scores for the proportion of tolerant individuals metric were extremely low at all of the sampling stations. The number of tolerant species and the proportion of tolerant individuals were high for most sampling stations and indicated that dissolved oxygen, sedimentation, or other water quality parameters might be impacting the fish community. The number of tolerant species was 4 at station 207-1171, 5 at station 207-1327, 5 at station 207-1601, and 4 at station 207-1828. These values were much higher than the mean value of 1.80 at the biological criteria reference streams in the Ozark ecoregion and much closer to the mean value of 3.90 at the biological criteria reference streams in the plains ecoregion (Doisy et. al. 2008). The proportion of tolerant individuals was 0.40 at station 207-1171, 0.28 at station 207-1327, 0.30 at station 207-1601, and 0.13 at station 207-1828. These values were much higher than the mean value of 0.04 at the

biological criteria reference streams in the Ozark ecoregion (Doisy et. al. 2008). The proportion of tolerant individuals at the NFSR stations except at 207-1828 were close to the value of 0.32 found at the biological criteria reference streams in the plains ecoregion (Doisy et. al. 2008).

Table 19
EMAP Fish IBI Values and Scores

Sampling Station	**207-1327**	**207-1171**	**207-1601**	**207-1828**
Sample Date	06/26/06	08/17/06	06/27/06	08/17/06
Metric				
# of Individuals Collected	969 (10)	684 (10)	1072 (10)	595 (10)
# of Native Species	25 (10)	26 (10)	36 (10)	27 (10)
# of Native Minnow Species	6 (8)	4 (5.3)	7 (9.2)	6 (7.9)
# of Native Sunfish Species	4 (10)	4 (10)	4 (9.5)	4 (9.3)
# of Native Benthic Species (including round bodied suckers)	7 (8.8)	7 (8.6)	15 (10)	9 (9.2)
# of Native Water Column Species	11 (10)	11 (10)	11 (10)	10 (10)
# of Long-lived Species (expected life span > 4 yrs)	10 (9.7)	11 (10)	19 (10)	18 (10)
Proportion of Tolerant Individuals	0.28 (1)	0.40 (1)	0.30 (1)	0.13 (1)
Proportion of Individuals as Carnivores	0.13 (10)	0.24 (10)	0.06 (8.9)	0.06 (9.1)
Proportion of Individuals as Insectivores and Invertivores	0.10 (4.1)	0.10 (4)	0.18 (7.4)	0.20 (7.9)
Proportion of Individuals as Omnivores and Herbivores	0.22 (6.1)	0.26 (5.4)	0.35 (3.8)	0.34 (4.1)
Total EMAP IBI Score	87.7	84.3	89.8	88.5

Metric scores are shown in parentheses. Maximum score for each metric is 10 and was calibrated by stream size by using $\log_{10}$ mean wetted stream width and ecoregion.

The fish samples showed that a large percentage of individuals sampled were species that are commonly found in pools. This included many bass, catfish, round bodied sucker, and sunfish species. Sunfish species were generally the most abundant species found in the samples. Four sunfish species, the bluegill (*Lepomis macrochirus*), green sunfish (*Lepomis cyanellus*), longear sunfish (*Lepomis megalotis*), and orangespotted sunfish (*Lepomis humilis*) were very abundant in most of the samples. Two of the sunfish species, the bluegill and the green sunfish, were classified as tolerant and were very abundant in all of the samples except sample 207-1828 (Table 17). The green sunfish is considered one of the most tolerant fish species in Missouri and can tolerate extremes in turbidity, dissolved oxygen, water temperature, and flow (Pflieger 1997). The orangespotted sunfish was very abundant in two of the samples and is commonly found in streams with high turbidity and sediment (Pflieger 1997). Three minnow species that are commonly found in pools, the bigeye shiner (*Notropis boops*), bluntnose minnow (*Pimephales notatus*), and the red shiner (*Cyprinella lutrenis*) were common in some of the NFSR samples. The red shiner is classified as tolerant and is commonly found in streams with high turbidity and siltation. Darter species were generally in low abundance except for the

fantail darter (*Etheostoma flabellare*) and the orangethroat darter (*Etheostoma spectabile*). These species can occur in prairie streams and are considered more tolerant of turbidity than most darters (Pflieger 1997). Many larger bodied species like the largemouth bass (*Micropterus* salmoides), flathead catfish (*Pylodictis olivaris*), northern hogsucker (*Hypentelium nigricans*), and redhorse sucker (*Moxostoma* species) that usually occur in runs or pools were found in low to moderate numbers at the NFSR stations.

3.6.2 Stream Habitat Measurements

Stream habitat measurements related to the banks, riparian zone, substrate, residual pool volume, and the stream channel were collected at the MDC RAM sampling stations (Table 20) and were based on EMAP protocols (Kaufman et al. 1999). Three final habitat indices, QCPH, QPH, and QTPH, were calculated from the collected stream measurements and used to evaluate stream habitat at the sampling stations. Mean stream measurements that were available from Doisy et al. (2008) were included in Table 20 and used as a comparison to the values from the NFSR sampling stations. The bank angle and undercut distance of the bank, except the NFSR station located near NFSR #9 (207-1327), were near the mean values of the reference streams (Table 20). Station 207-1327 had a steeper mean bank angle and undercut distance than the other sampling stations. The NFSR sampling stations had higher bankfull height values than the reference streams of both ecoregions. Bankfull height was defined as the channel height at bankfull water levels. Channel incision height was much greater than the reference streams of both ecoregions except at NFSR 207-1327 which had a value similar to the mean value of the reference streams from the Ozark ecoregion. Channel incision height was defined as the depth measured from the water surface to the first valley terrace above bankfull height.

The results of the riparian zone showed that all three levels of the riparian zone (canopy, mid-level, and ground cover) were present. The percent of riparian zone within the sample reach that contained large trees that might provide bank stability, shading, and aquatic habitat ranged from 25 to 40 percent at the NFSR stations. Mean bank canopy density at the NFSR stations was higher, except at the most downstream station (207-1828), than mean values of the reference streams for both the Ozark and plains ecoregions. All of the NFSR stations had higher mid-channel canopy density values than the Ozark ecoregion reference streams, except the station near NFSR #9 (207-1327) and the most downstream station, 207-1828, which were slightly lower than the mean value for the plains ecoregion.

Embeddedness was much higher at the NFSR sampling stations than the Ozark reference streams, but was lower than embeddedness in the plains reference streams. Station 207-1327 had a much higher embeddedness value than the other three stations and was the only station that was close to the mean embeddedness value for the plains ecoregion. The NFSR samples had an average substrate size class that was similar to the reference streams in the Ozark ecoregion. The amount of estimated sand and fine material was lower except at the station near NFSR #2 (207-1601) compared to the reference streams in the Ozarks and all of the stations were much lower than the reference streams in the plains. Most of the substrate in the NFSR sampling stations was in the fine and coarse gravel substrate classes. Most of the stations had more fine gravel and less coarse gravel than the Ozark reference streams, and had more than the plains reference

streams for both size classes. The NFSR sampling stations had a lower amount of cobble, except for NFSR #1, than the Ozark reference streams and a higher percentage of the stream bottom covered by bedrock than reference streams from both ecoregions.

The residual pool volume and channel measurements showed that the sampling reaches of the NFSR stations were made up primarily of 1 to 2 larger pools with high water depths. Pools made up a much higher percentage of the sample reach at the NFSR stations than the reference streams from both ecoregions, ranging from 75 to 92 percent of the sample reach. Fast water habitat made up a very small percentage of sample reach at most of the NFSR stations. The station located near NFSR #2 (207-1601) was the only station that had more fast water habitat than the plains reference streams and close to the amount of fast water habitat found at the Ozark reference streams. Mean thalweg depth ranged from 1.6 feet to 2.1 feet and the standard deviation of the thalweg depths were high, ranging from 1.0 foot to 1.4 feet. The wetted width to water depth ratio was much lower at the NFSR stations than the reference streams, indicating that a higher proportion of the wetted width had higher water depths.

Fish cover estimates were estimated visually at 11 transects and for the entire sampling reach. Filamentous algae were very abundant at station 207-1327 located near NFSR #9 and station 207-1601 located near NFSR #2. Aquatic macrophytes were very abundant at station 207-1107 located near NFSR #9. Aquatic macrophyte levels at the other stations were much lower and between the mean values for the Ozark and plains reference streams. Large woody debris was greater at stations 207-1171 and 207-1601, but most of the stations had large woody debris abundance that was similar to the levels at the reference streams. The most upstream station, 207-1327, was the only station that had a higher percentage for undercut banks and overhanging vegetation than reference streams from both ecoregions. Boulders were very abundant at all of the NFSR stations except 207-1327 and much greater than the reference streams from both ecoregions.

Large woody debris numbers and volume were measured at each sampling station. Large woody debris was most abundant at station 207-1171 located near NFSR #8 and station 207-1601. The large woody debris numbers and volume at these stations were near or slightly higher than the mean values at the Ozark reference streams and lower than the mean values at the plains reference streams. No woody debris was collected and measured at the most upstream station, 207-1327, and the values at the most downstream station, 207-1828, were much lower than reference values for both ecoregions.

Table 20
Stream Habitat Measurements Collected at the MDC RAM Sampling Stations

Habitat Measurement	MDC Habitat Code	Site Number 207-1171	Site Number 207-1327	Site Number 207-1601	Site Number 207-1828	Ozark Ecoregion Mean Reference Values	Plains Ecoregion Mean Reference Values
Banks							
Mean Bank Angle (degrees)	Xbka	25	44.8	35.7	15.6	30.4	31.5
Mean Undercut Distance (feet)	Xun	0.1	3.73	0	0	0.5	0.03
Mean Bankfull Height (feet)	XBKF_H	3.3	6.6	6.6	6.6	2.8	2.6
Mean Channel Incision Height (feet)	XINC_H	16.4	6.6	26.2	26.2	6.2	10.5
Riparian Zone and Canopy Density							
Riparian & Mid Layer Present (% of Reach)	Xpcm	100	81.8	100	100	-	-
Riparian 3 Layers Present (% of Reach)	Xpcmg	100	81.8	100	100	-	-
Riparian Canopy >0.3 m DBH (% of Reach)	XCL	40	25	33	35	-	-
Mean Bank Canopy Density (%)	XCDENBK	93.6	88.0	96.8	79.1	76.3	84.6
Mean Mid-channel Canopy Density (%)	XCDENMID	78.3	60.2	72.6	54.9	46.0	62.2
Substrate							
Mean Embeddedness (%)	XEMBED	46.3	60.7	45.8	35.6	24.4	67.0
Mean Substrate Size Class (1-6)	SUB_X	3.2	3.2	3.2	3.7	3.3	2.7
Percent Sand & Fines – <2 mm	PCT_SAFN	9.0	10.9	21.8	5.5	13.1	53.6
Percent Fine Gravel – 2-16 mm	PCT_GF	30.9	18.2	20.0	5.5	16.0	4.7
Percent Coarse Gravel – 16-64 mm	PCT_GC	36.36	50.91	27.27	38.2	41.4	17.8
Percent Cobble – 64-250 mm	PCT_CB	3.6	12.7	5.46	32.7	18.7	11.2
Percent Bedrock – >250 mm	PCT_BDRK	10.9	3.6	14.6	9.1	4.8	3.8
Residual Pool Volume							
Residual Pools >50 cm (>1.6 feet) deep (#/reach)	Rpgt50	2	1	1	0	1.9	1.8
Residual Pools >75 cm (>2.4 feet) deep (#/reach)	Rpgt75	0	1	1	0	1.0	0.9
Maximum Residual Depth (feet)	Rpmdep	2.3	3.1	2.5	-	3.1	3.1
Maximum Residual Width of Any Pool in Reach (feet)	Rpmwid	31.6	30.8	29.9	-	52.1	43.3
Residual Pool Volume (ft^3/328 ft. channel)	Rpv100c	423.0	734.4	193.1	-	-	-
Channel Characteristics							
Sinuosity	Sinu	1.6	1.0	1.1	1.0	1.1	1.2
Mean Thalweg Depth (feet)	Xdepth	1.7	2.0	2.1	1.6	-	-
Standard Deviation of Thalweg Depth (feet)	Sddepth	1.0	1.1	1.4	1.1	-	-
Mean Bankfull Width (feet)	XBKF_H	61.4	190.0	74.82	68.0	85.9	54.1

Table 20 Continued
Stream Habitat Measurements Collected at the MDC RAM Sampling Stations

Habitat Measurement	MDC Habitat Code	Site Number 207-1171	Site Number 207-1327	Site Number 207-1601	Site Number 207-1828	Ozark Ecoregion Mean Reference Values	Plains Ecoregion Mean Reference Values
Mean Wetted Width (feet)	Xwidth	28.0	30.1	45.4	29.9	-	-
Mean Wetted Width/Depth Ratio	Xwd_rat	17.6	19.2	27.2	19.7	51.4	43.0
Percent Fast Water (% Riffle and Faster)	PCT_FAST	0	5	18	0	24.0	9.1
Percent Pool	PCT_POOL	92	79	66	75	30.9	56.3
Percent Dry Channel or Subsurface Flow	PCT_DRS	8	0	0	25	-	-
Fish Cover							
Filamentous Algae (% of Reach)	XFC_ALG	5	23	25	5	2	3
Aquatic Macrophytes (% of Reach)	XFC_AQM	22	9	4	9	11	2
Large Woody Debris (% of Reach)	XFC_LWD	7	0	8	3	7	5
Undercut Banks (% of Reach)	XFC_UCB	2	5	3	4	2	4
Overhanging Vegetation (% of Reach)	XFC_OHV	1	12	1	7	7	3
Boulders (% of Reach)	XFC_RCK	25	3	19	28	7	8
Large Woody Debris (LWD)							
LWD in Bankfull Channel (#/328 ft. of Channel-all sizes)	C1Wm100	9.0	0	9.3	3.7	7.3	10.7
LWD Volume in Bankfull Channel (ft^3/328 ft. of Channel)	V1Wm100	267.6	0	206.9	44.1	215.4	402.5
Final Habitat Indices							
Channel Physical Habitat Index 1	QCPH1	0.5	0.5	0.5	-	0.7	0.6
Channel Physical Habitat Index 2	QCPH2	0.5	0.5	0.5	-	0.7	0.6
Channel + Riparian Quality Index 1	QPH1	0.6	0.5	0.6	-	0.7	0.6
Channel + Riparian Quality Index 2	QPH2	0.6	0.5	0.5	-	0.7	0.6
Channel + Riparian + Riparian Human Disturbance Index 1	QTPH1	0.6	0.6	0.6	-	0.7	0.6
Channel + Riparian + Riparian Human Disturbance Index 2	QTPH2	0.6	0.6	0.6	-	0.7	0.6

The value of 1 following the final habitat indices is not adjusted to watershed size and the value of 2 adjusts the indices to watershed size.

Three habitat indices were calculated from the stream measurements so that habitat conditions could be assessed. Two calculations were done for each index, one that was not adjusted for watershed size and one that adjusted the index value based on watershed size. No indices were calculated for station 207-1828 since some of the stream measurements were not collected at this station. The first index was called QCPH and was based on the in channel physical habitat measurements. The second index was called QPH and was based on in channel measurements and riparian zone quality. The last index was called QTPH and was based on in channel habitat, riparian quality, and human disturbance in the riparian zone. Types of human disturbance in or near the riparian zone that were used in the QTPH were the following: dikes, revetments, buildings, roads, railroads, pipes, landfills, trash, parks, lawns, row crops, pasture, and logging and mining activities. The NFSR stations had lower index values than the reference streams for QCPH1 and QCPH2, which indicates that in channel habitat conditions at the NFSR sampling stations were not as good as the reference streams. The QPH index was determined by channel and riparian measurements and showed that all of the NFSR stations had slightly lower index values than the Ozark reference streams. Two of the NFSR stations were slightly lower than the plains reference streams when watershed size was used to adjust the value of the index (QPH2). The last index, QTPH, was based on channel measurements, riparian condition, and human disturbance of the riparian zone. It showed that the NFSR stations had slightly lower index values than Ozark reference streams, but not the reference streams in the plains ecoregion.

3.6.3 Water Quality

Water quality parameters collected during fish sampling are shown in Table 21. Physicochemical results that violated Missouri water quality standards or were elevated compared to U.S. EPA recommended reference condition values are discussed in this section.

3.6.3.1 Turbidity

Turbidity ranged from 16 NTU to 75.2 NTU and was elevated compared to the U.S. EPA recommended reference condition values for the Ozark highland and Central Irregular Plains Ecoregions. The recommended reference condition for turbidity in the Ozark Highlands Ecoregion is 1.43 NTU and 15.5 NTU for the Central Irregular Plains Ecoregion.

3.6.3.2 Nitrate + Nitrite

Nitrate was slightly elevated at the two stations that were sampled on June 26, 2006. Nitrate was 0.66 mg/L at station 207-1327 and 0.93 mg/L at station 207-1601. The recommended reference condition value for the Ozark Highland Ecoregion is 0.24 mg/L and 0.23 mg/L for the Central Irregular Plains Ecoregion.

3.6.3.3 Total Phosphorus

Total phosphorus ranged from 0.24 mg/L to 0.28 mg/L at the sampling stations and was slightly elevated compared to U.S. EPA recommended reference condition values. Recommended reference condition for the Ozark Highlands Ecoregion is 0.006 mg/L and 0.09 mg/L for the Central Irregular Plains Ecoregion.

Table 21
Physicochemical Variables Collected at the MDC RAM Sampling Stations

	Site Number 207-1171	Site Number 207-1327	Site Number 207-1601	Site Number 207-1828
Sample Date	08/17/2006	06/26/2006	06/26/2006	08/18/2008
Sample Time	1000	1115	0815	0900
Dissolved Oxygen	**2.32**	5.60	**3.27**	**3.61**
Water Temperature (C^0)	25.1	22.7	22.5	27.91
Conductivity (umhos/cm)	231	242	213	305
pH	7.74	7.58	7.70	7.71
Discharge (cfs)	No Flow	6.32	9.61	No Flow
Turbidity (NTU)	**75.2**	**42.3**	**60.3**	**16.0**
Non Volatile Suspended Solids	5.6	16.0	24.6	17.5
Volatile Suspended Solids	2.33	3.71	4.13	4.7
Dissolved Organic Carbon	7.0	6.0	7.8	7.9
Calcium	34.8	35.4	24.4	39.9
Magnesium	3.5	3.3	3.5	4.7
Potassium	9.9	8.8	9.9	8.7
Sodium	5.8	6.7	9.8	15.8
Ammonia	0.07	0.08	0.11	0.04
Nitrate + Nitrite	0.05	**0.66**	**0.93**	0.05
Total Phosphorus	**0.24**	**0.28**	**0.27**	**0.22**
Total Benthic Chlorophyll	0.03	0.02	0.01	0.03

Units mg/L unless otherwise noted. Values in bold are elevated compared to U.S. EPA recommended reference condition values or violate Missouri Water Quality Standards.

3.6.3.4 Dissolved Oxygen
Dissolved oxygen at the sampling stations ranged from 2.32 mg/L to 5.60 mg/L. Dissolved oxygen was below the 5 mg/L Missouri water quality standard at all of the sampling stations except station 207-1327.

4.0 Discussion
The discussion describes possible effects of land use, geology, soil type, sedimentation, and physicochemical stressors on the macroinvertebrate and fish community composition.

4.1 Fish and Macroinvertebrate Biological Assessment Comparison
The results of the macroinvertebrate biological assessment indicate that the NFSR was impaired or close to impairment since most of the sampling stations that scored in the fully sustainable range had the minimum MSCI score of 16. Fish on the other hand, had very high MIBI scores, ranging from 39 to 45 and did not show impairment (Table 18).

This fish community was diverse and had a high abundance of species that are commonly found in pools (Table 16). The percent of cyprinid insectivore individuals was the only metric that generally performed poorly. The EMAP IBI also showed that the NFSR sampling stations had a very diverse fish community that contained a high number and/or proportion of benthic species and species that are commonly found in pools (Table 19). The scores for the EMAP IBI ranged from 84.3 to 89.8 out of the possible maximum score of 110. However, three metrics in the EMAP IBI were generally low at most sampling stations and could indicate stress from low dissolved oxygen and sedimentation.

A previous study by Berkman et al. (1986) found that macroinvertebrates were a better indicator of sedimentation than fish. Most macroinvertebrates live on the stream bottom and in streams with high levels of benthic sediment. The abundance of clingers usually is low while the abundance of collector-gatherers, especially burrowers, is high. The NFSR sampling stations that had higher levels of benthic sediment had very low abundances of clingers.

Sedimentation generally affects fish less directly than invertebrates. The primary impact of sedimentation on the fish community is the invertebrate food supply, feeding efficiency, and reproduction. Increased sedimentation may reduce the amount of quality food, increase turbidity which reduces the ability of fish to see prey, and reduce the reproductive success of fish that require clean gravel substrate to spawn (lithophils). A study by Berkman and Rabeni (1987) found that streams with higher benthic sediment in the riffles had fish communities that had a higher abundance of fish species commonly found in run and pool habitats than streams with lower levels of benthic sediment in the riffles. This study found that as sedimentation in riffles increased, the relative abundance of benthic insectivores, benthic herbivores, and fish from the simple lithophilous reproductive guild decreased while general insectivores and fish from the simple miscellaneous reproductive guild increased. Based on the results of this study, metrics not included in the MIBI that might indicate impairment caused by sedimentation are the number and/or percent of benthic insectivores, benthic herbivores, and tolerant species.

Another possible stressor in the NFSR is low dissolved oxygen. The macroinvertebrate community structure had a high abundance of taxa that are tolerant of low dissolved oxygen levels, providing evidence that dissolved oxygen levels were a possible source of impairment. A high proportion of the fish community in the NFSR was tolerant of low dissolved oxygen levels based on a study done by Smale and Rabeni (1995). Low dissolved oxygen tolerant individuals composed 41.4% at station 207-1327, 60.1% at station 207-1171, 59.7% at station 207-1601, and 24.6% at station 207-1828. Some of the fish species found in the NFSR samples were not assessed for dissolved oxygen tolerance since the Smale and Rabeni study (1995) emphasized fish species found in Missouri headwater streams. Species that were found in the NFSR samples that were classified as tolerant by Smale and Rabeni (1995) are ranked from decreasing to increasing tolerance as follows: johnny darter; golden shiner; largemouth bass; longear sunfish; bluegill; orangespotted sunfish; slender madtom; and yellow bullhead. The four *Lepomis* sunfish species were very abundant in the samples except at the most downstream station 207-1828 and made up most of the high percentage of hypoxia tolerant individuals.

The results of this study indicate that the newly developed MIBI has some metrics that might indicate impairment for sedimentation, but may not have metrics that detect impairment caused by low dissolved oxygen. However, there was no evidence that benthic sediment was elevated at the fish sampling stations based on the stream habitat measurements collected by MDC and the sediment samples collected at the nearby MDNR stations. The MIBI did have some metrics, such as the number of native benthic species and the number of all native lithophilic species, which should be indicative of excessive sedimentation. Metrics that might show impairment caused by low dissolved oxygen, such as the number or percent of low dissolved oxygen tolerant species and the number or percent tolerant species as defined in the MDC RAM SOP (Fischer and Combes 2003), were not included in the MIBI.

4.2 Benthic Sediment Impacts on the MSCI Scores

Benthic sediment is a possible stressor at NFSR #5 and NFSR #10 based on benthic sediment levels and MSCI scores. North Fork of the Spring River #5 had a significantly higher amount of silt than all of the other sampling stations and a significantly higher amount of total benthic sediment (sand + silt) than all of the other sampling stations except LDC #2 (Table 14). Benthic sediment may not be the only stressor since the station only showed impairment during the fall sampling season. The high benthic sediment levels were most likely still present during the spring sampling season since the station was a long pool for the entire sampling reach. This would make it difficult for rapid movement of sediment during high flow events that might have occurred between the summer of 2006 and the spring of 2007. The habitat assessment and field notes for the bioassessment in the fall 2006 sampling season also indicated that benthic sediment deposition was high at NFSR #5. Another indication that benthic sediment may not be the only stressor is evident at NFSR #4, the closest downstream station. NFSR #4 showed impairment for the two duplicate macroinvertebrate samples during the fall 2006 sampling season, even though it had much lower benthic sediment levels.

North Fork of the Spring River #10, a transitional station located just upstream of Golden City, had a significantly higher amount of silt than the closest downstream station, NFSR #9, and the

two biological criteria stations in the transitional area of the Ozark/Osage EDU (Cedar and Horse creeks). North Fork of the Spring River #10 MSCI scores indicated impairment for both sampling seasons and the higher amount of silt is a possible stressor. Other test stations showing impairment based on the MSCI scores during the spring 2007 sampling season were NFSR #1, NFSR #7, NFSR #8, and NFSR #9b. There was no strong evidence that benthic sediment was the stressor. North Fork of the Spring River #8 was the only other upstream station besides NFSR #10 that had a fairly high amount of benthic sediment. This station had the third highest mean for silt and total sediment at NFSR test stations, but also had a high standard deviation for both silt and total sediment, indicating high variation between transects. The other stations that showed impairment during the spring 2007 sampling season had a low amount of benthic sediment compared to the other test stations and the biological criteria reference stations. The duplicate sample for NFSR #9b, NFSR #9a, showed no impairment since it had an MSCI score of 16 while NFSR #9b had an MSCI score of 12. The difference in the MSCI scores for the duplicate samples resulted from 5 less taxa in TR and 1 less EPTT for the NFSR #9b sample.

4.3 Low Dissolved Oxygen Impacts on MSCI Scores

Data collected for this study and data collected by MEC Water Resources Inc. for the Ecological and Water Resources Assessment Project (**EWRAP**) shows dissolved oxygen levels at the NFSR test stations and the biological criteria reference streams in this study were consistently low during the summer and fall of 2006. Dissolved oxygen datalogger data was collected for EWRAP at three stations in Cedar Creek and five stations in LDC. The dissolved oxygen data collected in Cedar Creek, including Cedar Creek station #1 for this study (EWRAP = CC#2), ranged from 52 to 67 percent of the readings below the 5 mg/L criteria. Dissolved oxygen data was collected from July 12, 2006 to August 6, 2006 at Cedar Creek #1. It was below the 5 mg/L criteria 75 percent of the time and the diel fluctuation of the dissolved oxygen readings were very high, ranging from 0 to greater than 20 mg/L on some days. This was most likely caused by the high amount of filamentous algae that was present at the station in the summer and fall of 2006. Dissolved oxygen data were collected at five stations on Little Drywood Creek, including two stations near LDC #2 (EWRAP = LDC-1 and LDC-2) and one station near LDC #1 (EWRAP = LDC-5). The dissolved oxygen readings at the LDC stations that were below the 5 mg/L water quality standards criteria ranged from 76 percent at LDC-2 to 100 percent at LDC-5. Horse Creek #1 had extremely low dissolved oxygen readings ranging from 0.19 to 2.32 mg/L from datalogger data collected for this study.

Datalogger data and discrete dissolved oxygen readings indicated that dissolved oxygen levels were consistently low at all of the test stations during the summer and fall of 2006. Approximately 98% of the combined datalogger readings from NFSR #3, NFSR #6, and NFSR #9 were below the 5 mg/L water quality standards criteria. Test station #1 was slightly better with about 80 percent of the dissolved oxygen readings below the 5 mg/L criteria. Test station #1 had a much wider, less shaded channel and more flow than most other test stations which probably led to higher dissolved oxygen levels during the afternoon hours. Comparatively, the datalogger at NFSR #3 was deployed during the same time period as NFSR #1 and all dissolved oxygen readings were below the 5 mg/L water quality standard. Test station #3 had a well shaded narrow channel with high water depths, low flow, and high abundance of woody debris,

which most likely led to the lower dissolved oxygen readings at this station (0.33 mg/L to 3.57 mg/L).

There is evidence that dissolved oxygen and a high abundance of planktonic algae might have been a stressor source at NFSR #4 and NFSR #5. No dataloggers were deployed at these stations, but all dataloggers deployed at other NFSR stations had low dissolved oxygen levels from late August to early September (Figures 4-12). Field notes recorded during site recon and datalogger deployment indicated that planktonic algae were present in the water column at NFSR #4 and #5 from late July to early August (Table 11). The algae were present at stations visited on July 31, August 7, and August 10, 2006. The planktonic algae were not present on the next site visit on August 31, 2006 at NFSR #4. The next date NFSR #5 was visited after August 10, 2006 was September 26, 2006 and planktonic algae were not observed. The planktonic algae most likely decreased or disappeared at both stations sometime in mid or late August. The presence of the planktonic algae affected the water quality by increasing turbidity and most likely caused a greater fluctuation in the diel dissolved oxygen levels. The difference between the lowest and highest dissolved oxygen values in a 24-hour period when the planktonic algae were present was probably much higher because of increased photosynthesis during the daylight hours and increased respiration during the nighttime hours. There was evidence that the algae biomass was influencing the diel dissolved oxygen levels on August 7, 2006 since discrete dissolved oxygen readings collected at NFSR #4 and NFSR #5 were much higher than the readings collected at other test stations and weather conditions were sunny on that date (Table 11). The dissolved oxygen levels at NFSR #4 and NFSR #5 were much lower three days later, on August 10, 2006, and most likely were caused by the cloudy and rainy weather that occurred on that date. The Lamar WWTF lagoon was the most likely source of the planktonic algae.

The low dissolved oxygen levels probably influenced the macroinvertebrate community structure in the NFSR test stations, but may not be the primary or only stressor since the only stations that had MSCI scores in the partial sustainability range were NFSR #4, NFSR #5, and NFSR #10 during the fall 2006 sampling season. The macroinvertebrate community of the NFSR test stations and the three biological criteria streams most likely evolved and adapted to the low dissolved oxygen conditions present in these streams during low flow periods.

4.4 Other Water Quality Impacts on MSCI Scores

Other possible stressor sources were water levels, high turbidity, and high nutrient levels. Test station #10 had very low water levels during the summer and fall of 2006. The station was pooled on the first site visit on July 31, 2006 and was still pooled when macroinvertebrates were sampled on October 3, 2006. This station has a much smaller watershed size than the other test stations, but still had three long, deep pools with water depths that were similar to the other NFSR test stations during the summer and fall of 2006.

A major rain event created very high water levels during the spring 2007 sampling season. Stations NFSR #2, NFSR #3, NFSR #7, NFSR #8, NFSR #9, and LDC #1 were sampled on April 3-5, 2007 while the other NFSR test stations were sampled before the river rise on March 19-20, 2007. The substantial rise in the river could have scoured the stream bottom, possibly

impacting the macroinvertebrate community at the stations that were sampled after the rain event. The evidence supporting this as a possible stressor source is limited since NFSR #2, NFSR #3, and LDC #1 MSCI scores did not show impairment and TR was at least 50 in all of the samples collected after the rain event.

The majority of the macroinvertebrate taxa found in samples collected for this study, especially at NFSR and LDC stations, are considered tolerant of organic pollution. All of the macroinvertebrate samples collected during the fall 2006 sampling season had biotic index values near or above 8.0 except NFSR #1 which had a biotic index value of 7.48. All three stations that showed impairment during the fall 2006 sampling season had extremely high biotic index values ranging from 8.29 at NFSR #4a to 8.62 at NFSR #10. The 75th percentile values used to calculate biotic index criteria for biological criteria reference streams in EDUs near the NFSR were much lower than the biotic index values at the NFSR test stations (Table 22). The biotic index values were better at the NFSR test stations during the spring 2007 sampling season with many stations having biotic index values below 8.0. These results indicate that the percentage of the macroinvertebrate samples made up of tolerant taxa were higher at most of the NFSR test stations than the biological criteria streams in the Central Plains/Osage/South Grand, Ozark/Neosho, and Ozark/Osage EDUs. EPTT, generally considered intolerant of organic pollution, ranged from 1 taxa at NFSR #10 to 3 taxa at NFSR #5 and were extremely low at all of the NFSR test stations. These stations showed impairment during the fall 2006 sampling season. Two of the five stations that showed impairment during the spring 2007 sampling season, NFSR #8 and NFSR #10, had biotic index values over 8.0. EPTT ranged from 1 taxa at NFSR #10 to 3 taxa at NFSR #7 and NFSR #9b. These stations showed impairment during the spring 2007 season. These results indicate that there was a higher percentage of macroinvertebrate samples made up of taxa tolerant to organic pollution at most NFSR test stations compared to the biological criteria streams in the Central Plains/Osage/South Grand, Ozark/Neosho, and Ozark/Osage EDUs.

Table 22
Biotic Index Criteria for EDUs Near the NFSR and Reference Streams (Cedar and Horse creeks) in the Transitional Area of the Ozark/Osage EDU

Ecological Drainage Unit	Fall Season	Spring Season
Central Plains/Osage/South Grand	7.73	7.16
Ozark/Osage	6.68	6.20
Ozark/Neosho	5.50	5.28
Cedar/Horse Creeks	6.88	6.38

Nutrients and turbidity could be stressors on the macroinvertebrate community, but there was not a strong relationship between the water quality parameters and MSCI scores. The MSCI scores at NFSR #3 did not show impairment during the fall 2006 sampling season even though ammonia was in violation of the chronic water quality standards and total nitrogen was extremely high. Turbidity was elevated at NFSR #7-NFSR #9, ranging from 39.4 to 49.4 NTU, but none of these stations were impaired based on the MSCI scores. Turbidity was also elevated at the four MDC sampling stations ranging from 16.0 to 75.2 NTU (Table 21). Total nitrogen

was slightly elevated at all of the test stations, but there was no evidence it was a stressor since it was not dramatically higher at stations showing impairment during the fall 2006 sampling season. Planktonic algae were very abundant at NFSR #4 and NFSR #5 in early August and elevated levels of nutrients, if present at that time, may have allowed the algae to thrive.

Nitrate + nitrite-N and total nitrogen were elevated at all of the NFSR test stations during the spring 2007 sampling season, but it is unknown what stress the high nitrogen levels had on the macroinvertebrate community. Total nitrogen levels at the NFSR stations showing impairment during the spring 2007 sampling season were over 2 mg/L and much higher than recommended U.S. EPA total nitrogen reference condition values. But other test stations that did not show impairment also had elevated nitrogen levels ranging from 1.64 mg/L at NFSR #5 to 2.58 mg/L at NFSR #2. A possible source of the elevated nitrogen was surface runoff since the test stations were either sampled during or two weeks after a major rain event that caused the river's water levels to rise above its banks. Nutrient levels during both sampling seasons indicated a slightly eutrophic condition in the NFSR during the fall and spring sampling seasons, but its stress on the macroinvertebrate community is unknown since only some of the stations showed impairment.

4.5 Macroinvertebrate Community Structure

The most abundant and commonly found macroinvertebrates were also organic pollution tolerant taxa. There was a difference in macroinvertebrate community structure between samples that showed impairment and samples that did not. During the fall 2006 sampling season, the stations that showed impairment (NFSR #4a, NFSR #4b, NFSR #5, and NFSR #10) had a much lower percentage of the samples made up of EPTT and clingers. These two metrics could be a good indicator of organic pollution, low dissolved oxygen, and high amounts of benthic sediment. Macroinvertebrates that are included in these metrics are normally more intolerant of pollution and need a hard surface for clinging or attachment. *Caenis latipennis* was the only EPTT that was abundant at the NFSR test stations, but was generally in lower abundance at the impaired stations. Tolerant Tubificidae and Chironomidae taxa were very abundant at the stations showing impairment during the fall 2006 sampling season. Stations NFSR #4 and NFSR #5 had a high abundance of large woody debris, which in turn had a high density of very tolerant *Glyptotendipes*. *Glyptotendipes* commonly occur in detritus rich sediments of slow flowing rivers and become abundant in areas of organic pollution (Simpson and Bode 1980; Wiederholm 1983). Tubificidae worms including Tubificidae, *Quistradrilus multisetosus*, and *Aulodrilus* were also abundant at NFSR #4 and NFSR #5. Tubificidae also dominated NFSR #10 during the fall 2006 sampling season, making up 20.4 percent of macroinvertebrates in the sample. The rest of the sample was dominated by *Branchiura sowerbyi*, *Goeldochironomus*, *Kiefferulus*, and Sphaeridae. These taxa are pollution tolerant and made up from 8.0 to 10.7 percent of the sample. These results indicate that low dissolved oxygen, nutrients, and/or benthic sediment could have altered the macroinvertebrate community at the impaired stations since all of these taxa are generally tolerant.

The macroinvertebrate samples that showed impairment during the spring 2007 sampling season had a very low percentage of EPTT and clingers, except NFSR #7. *Caenis latipennis* was the only EPTT that was abundant at the NFSR stations. Chironomidae and Tubificidae taxa made up

most of the taxa of the impaired stations. *Cricotopus/Orthocladius* group and the very tolerant *Hydrobaenus* were much more abundant than other Chironomidae taxa at most of the impaired stations. These two taxa made up approximately 50 percent of the macroinvertebrates found in the samples at NFSR #9 and NFSR #10. The intolerant Chironomidae taxa *Eukiefferiella brevicalicar* group was abundant at NFSR #7, NFSR #9, and the reference stream stations at Horse Creek and Cedar Creek. *Physella* was also very abundant at the impaired stations, except at NFSR #10. Station NFSR #5 did not show impairment, but clingers only made up 0.3 percent of the macroinvertebrate sample in the spring 2007 sampling season. The low percentage of clingers, high levels of benthic sediment, and the high biotic index at NFSR #5 are evidence that the macroinvertebrate community is dominated by tolerant taxa. North Fork of the Spring River #5 had a distinct macroinvertebrate community with much higher abundances of *Dicrotendipes*, *Glyptotendipes*, *Procladius*, and Planariidae that were much more abundant than at the other test stations. High benthic sediment levels at NFSR #5 and NFSR #10 could be causing the low abundance of EPTT, clingers, and intolerant taxa at these stations. The other upstream stations that showed impairment had very low abundances of intolerant taxa, but only NFSR #8 had fairly high levels of benthic sediment.

4.6 Land Use and AES Type Effects on Benthic Sediment

Row crops in the NFSR watershed made up a higher percentage of the land use than the three watersheds containing the reference streams sampled in this study. Row crops ranged from 35 to 60 percent. The high row crop land use in the NFSR watershed is potentially responsible for the higher amounts of benthic sediment deposits. However, the 14-digit HU containing NFSR #5 had significantly higher benthic sediment than the other sampling stations, except LDC #2, but had a lower percent row crops than the adjacent HU that contained NFSR stations #2-#4 (Table 15). This indicates that land use was not the primary cause of the amount of benthic sediment at NFSR #5 or the land use data was not calculated at a scale suitable to show local impacts at NFSR #5. The two LDC stations were another example of land use data not matching benthic sediment data. Percent row crops at the LDC stations were much lower than all NFSR stations, but benthic sediment was higher at LDC stations than most NFSR stations. North Fork Spring River #10, which had the most benthic sediment at the NFSR stations after NFSR #5, seemed to have a better correlation with the land use data. The percent row crops for the 14-digit HU containing NFSR #10 was 60 percent and was much higher than the other test stations. North Fork Spring River #10 was located in a transitional area of the Ozark Highlands Ecoregion and had significantly higher amounts of benthic silt than Cedar and Horse creeks, the two biological criteria reference streams in the transitional area of the Ozark/Osage EDU.

Aquatic Ecological System types might be as important as or more important to benthic sediment amounts than land use. Little Drywood Creek and NFSR, which are both located in the South Deepwater Creek AES type, generally had more benthic sediment than Cedar and Horse creeks. The AES types that contain the Cedar and Horse creeks watersheds have bedrock deposits made primarily of limestone while sandstone and shale are predominant in the South Deepwater Creek AES type. The surface soil texture for the South Deepwater Creek AES type is made up primarily of silt loam, which is defined as material made of 50 percent or more silt and 12 to 27 percent clay or 50 to 80 percent silt and less than 12 percent clay. The surface soil texture for

AES types that contain Cedar and Horse creeks are made up of silt loams or loams. Loams are defined as soil material containing 28 to 50 percent silt, 7 to 27 percent clay, and less than 52 percent sand. The silt loams that predominate in the South Deepwater Creek AES type have more silt and clay content which creates the potential for greater amounts of fine benthic sediment in streams.

The visual estimates of bottom substrate recorded at the four NFSR MDC sampling stations showed fine sediment ranging from 5.5 to 21.8 percent (Table 20). Fine and coarse gravel substrate classes made up the highest percentage of the bottom substrate at most of the sampling stations. Physical habitat measurements were also collected by MDC RAM program at two LDC stations located within the biological criteria reference reach on June 20-21, 2006. The stations were located just downstream of LDC #2 (R0610-06) and a station located at LDC #1 (R0611-06). The percentage of fine sediment covering the stream bottom was 45.5 percent at R0610-06 and 70.9 percent at R0611-06, which was much higher than any of the NFSR sampling stations. The LDC stations also had a much lower percentage of the substrate made of gravel size classes with fine gravel ranging from 0 to 3.6 percent and coarse gravel ranging from 1.8 to 5.5 percent. These results indicate that the four transitional stations on the NFSR had much less fine sediment covering the stream bottom than the LDC stations. This was similar to the results of the MDNR benthic sediment samples.

4.7 Channel Morphology

Channel measurements showed that channels at the NFSR transitional stations were wider than the glide/pool stations. Most of the transitional stations had sampling reaches that were made up of short riffle/runs and very long pools that had deep water depths. The four MDC stations also showed the same trend with pools making up from 75 to 92 percent and mean thalweg depths ranging from 1.6 to 2.1 feet (Table 20). Test station #1 was exceptional in that it had a much wider channel, more defined riffle/run segments, and shallower water depths than the other transitional stations. The glide/pool stations had a u-shaped channel with steep banks that is common in glide/pool streams in western Missouri. The channel at the glide/pool stations was narrower, the wetted width filled a greater proportion of the channel, and water depth was deeper than the transitional stations. Sinuosity was higher at the glide/pool stations than the transitional stations, except NFSR #2. There was no evidence based on the channel and sinuosity measurements that the NFSR channel had been channelized or physically altered in a significant way since most of the stations had large pools with high average depths and sinuosity values were much greater than 1.

5.0 Conclusions

The macroinvertebrate MSCI scores indicated impairment at some MDNR sampling stations while the MIBI scores did not indicate impairment at any of the MDC sampling stations. These results can possibly be explained by the fact that macroinvertebrates are more directly impacted by sediment than fish. Another possible reason for the discrepancy between the two communities is that pool habitat was very abundant and many of the most abundant fish species prefer pool habitat. Finally, the MIBI did not include metrics that have or possibly could be shown to cause impact from sedimentation and low dissolved oxygen levels.

The first two null hypotheses were rejected. The first null hypothesis stated that benthic sediment, stream channel measurements, and dissolved oxygen of the NFSR test stations will not differ from the two biological criteria reference stations in a transitional area of the Ozark/Osage EDU and/or Little Drywood Creek, a biological criteria reference stream in the Central Plains/Osage/South Grand EDU. The second null hypothesis stated that benthic sediment, stream channel measurements, and dissolved oxygen will not differ between longitudinally separate reaches of the NFSR. Dissolved oxygen was consistently low during the summer and fall of 2006 at the NFSR test stations based on datalogger data and discrete measurements taken with a handheld unit. Dissolved oxygen data collected by MDNR and MEC Water Resources Inc. within the reference reaches at Cedar Creek, Horse Creek, and Little Drywood Creek showed that the biological criteria reference streams also had low dissolved oxygen readings during the summer and fall of 2006. The benthic sediment collected for this study showed that sediment was elevated at NFSR #5 and NFSR #10. Benthic sediment, especially silt, collected at NFSR #5 was significantly higher than the other test stations and the biological criteria reference streams. North Fork Spring River #10, located in the transitional reach, had a significantly higher amount of benthic silt than both biological criteria reference stations in transitional areas and the closest downstream transitional stations (NFSR #8 and NFSR #9). The geologic characteristics of the South Deepwater Creek AES type that NFSR flows through shows that the NFSR is distinctively different than any other stream system in the Ozark/Neosho EDU. The AES type of the NFSR watershed is strong evidence that the levels of sediment (benthic or suspended) should be assessed using data from the same or similar AES type and not from data collected in other AES watersheds in the Ozark/Neosho EDU.

The third and fourth null hypotheses were rejected. The third hypothesis stated that the macroinvertebrate community in the NFSR will not differ from the two biological criteria reference streams in a transitional area of the Ozark/Osage EDU and/or Little Drywood Creek, a biological criteria reference stream in the Central Plains/Osage/South Grand EDU. The fourth null hypothesis stated that the macroinvertebrate community will not differ between longitudinally separate reaches of the NFSR. Four out of 11 samples collected at the NFSR test stations showed impairment based on MSCI scores during the fall 2006 sampling season. Three of four samples showing impairment were at NFSR #4 and NFSR #5, which were the two closest downstream stations to the Lamar WWTF lagoon. The other station that showed impairment during the fall 2006 sampling season was NFSR #10, the most upstream station. The macroinvertebrate community at NFSR #4 and NFSR #5 was possibly impacted by the Lamar WWTF since planktonic algae, commonly discharged from wastewater lagoons, were abundant in the water column during site visits to these stations in late July and early August of 2006. The most likely stressors at NFSR #4 were low dissolved oxygen levels and the planktonic algae. The planktonic algae most likely caused greater extremes of dissolved oxygen over a 24-hour period because of increased photosynthesis and respiration, possibly causing greater stress on the macroinvertebrate community. The most likely stressors at NFSR #5 were benthic sediment, low dissolved oxygen levels, and planktonic algae. The most likely stressors at NFSR #10 were benthic sediment and low dissolved oxygen levels. There was evidence that benthic sediment may have impacted the macroinvertebrate community at NFSR #5 and NFSR #10 since a very

small percentage of the macroinvertebrate community was made of intolerant taxa like EPTT and clingers.

All of the biological criteria reference stations except LDC #1 showed impairment during the fall 2006 sampling season. Very low water levels were the most likely stressor of the reference stations. The three reference stations that showed impairment were significantly pooled. Coarse substrate could not be sampled at Horse and Cedar creeks and no rootmat could be sampled at LDC #2 because of low water levels. The spring 2007 data showed that the MSCI metrics improved at Cedar and Horse creeks compared to the fall 2006 data, but MSCI scores still indicated impairment. These results indicate that the macroinvertebrate community had still not recovered from the previous low water levels during the summer and fall of 2006.

Five out of 10 samples collected at the NFSR stations showed impairment based on MSCI scores during the spring 2007 sampling season. The stations that showed impairment during the spring 2007 sampling season were NFSR #1, NFSR #7, NFSR #8, NFSR #9b, and NFSR #10. Stressors were not as prevalent during the spring 2007 sampling season. Dissolved oxygen levels were not low during this sampling period and most stations that showed impairment did not have high levels of benthic sediment. North Fork Spring River #8 and NFSR #10 were the only stations showing impairment that had higher amounts of benthic sediment. North Fork Spring River #1 was the only station that was assessed using the stricter RP transitional area stream criteria. The only known possible stress for this station was the high nitrogen values, which were consistently high at all of the NFSR stations during the spring 2007 sampling season. There were no known stressors at NFSR #7 and NFSR #9b except the scouring of the stream bottom caused by a major rain event and the high nitrogen levels. All of the upstream stations except NFSR #10 were collected two weeks after a rain event that caused the NFSR to flood over its banks. It is not known what affect the flooding event had on the macroinvertebrate community since two downstream stations, NFSR #2 and NFSR #3, were collected during the same time period and the MSCI scores for those stations did not indicate impairment. There was some evidence that benthic sediment might have been a stressor at NFSR #8 and NFSR #10 during the spring 2007 sampling season. The macroinvertebrate community structure indicated possible impairment from sediment since EPTT, percent EPTT, and percent clingers were very low and the biotic index was very high at the two stations.

6.0 Recommendations

1. Conduct a watershed study that determines which major sub-watersheds of the NFSR are contributing the most sediment, oxygen demand, or other water chemistry changes to the NFSR and causing the impairment of the macroinvertebrate community.

2. Encourage best management practices that could reduce pollutants in surface runoff for parameters such as sediment, nutrients, and pesticides.

7.0 Literature Cited

Chapman, S.S., J.M. Omernik, G.E. Griffith, W.A. Schroeder, T.A. Nigh, and T.F. Wilton. 2002. Ecoregions of Iowa and Missouri (color poster with map, descriptive text, summary tables, and photographs). Reston, Virginia, U.S. Geological Survey (map scale 1:1,800,000).

Berkman, H.E., C.F. Rabeni, and T.P. Boyle. 1986. Biomonitors of Stream Quality in Agricultural Areas: Fish versus Invertebrates. Environmental Management 10:413-419.

Berkman, H.E. and C.F. Rabeni. 1987. Effect of Siltation on Stream Fish Communities. Environmental Biology of Fishes 18:285-294.

Haithcoat, T.L., M.A. Urban, C.F. Rabeni, and K.E. Doisy. 2003. Biophysical evaluation of reference streams in Missouri: Final report for the Missouri Department of Natural Resources. University of Missouri-Columbia, Columbia, Missouri 65211. 87 pp.

Fischer, S. and M. Combes. 2003. Resource Assessment and Monitoring Program: Standard Operating Procedures – Fish. Missouri Department of Conservation, Resource Science Division, Columbia, Missouri. 55 pp.

Kaufmann, P.R., P. Levine, E.G. Robison, C. Seeliger, D.V. Peck. 1999. Quantifying Physical Habitat in Wadeable Streams. United States Environmental Protection Agency, Environmental Monitoring and Assessment Program, Research Triangle Park, NC 27711. EPA-620-R99-003. 102 pp.

Missouri Department of Natural Resources. 2002. Biological Criteria for Wadeable/Perennial Streams of Missouri. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 32 pp.

Missouri Department of Natural Resources. 2003a. Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 24 pp.

Missouri Department of Natural Resources. 2003b. Required/Recommended Containers, Volumes, Preservatives, Holding Times, and Special Sampling Considerations Standard Operating Procedure. MDNR-ESP-001. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 21 pp.

Missouri Department of Natural Resources. 2003c. Flow Measurements in Open Channels Standard Operating Procedure. MDNR-ESP-113. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 9 pp.

Missouri Department of Natural Resources. 2003d. Taxonomic Levels for Macroinvertebrate Identification. MDNR-ESP-209. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 32 pp.

Missouri Department of Natural Resources. 2004a. Upper North Fork of the Spring River Biological Assessment Study. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 34 pp.

Missouri Department of Natural Resources. 2004b. Lower North Fork of the Spring River Biological Assessment Study. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 32 pp.

Missouri Department of Natural Resources. 2005a. Rules of the Department of Natural Resources Division-Clean Water Commission, Chapter 7-Water Quality. 10 CSR 20-7.031. Water Quality Standards. pp. 10-136.

Missouri Department of Natural Resources. 2005b. Lamar Wastewater Treatment Plant, North Fork of the Spring River Stream Survey Sampling Report. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 6 pp.

Missouri Department of Natural Resources. 2005c. Field Sheet and Chain-of-Custody Record. MDNR-ESP-002. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 8 pp.

Missouri Department of Natural Resources. 2006. Dissolved Oxygen, Benthic Sediment, and Bioassessment Study Proposal, North Fork of the Spring River. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 6 pp.

Pflieger, W.L. 1989. Aquatic Community Classification System for Missouri. Missouri Department of Conservation Aquatic Series No. 19. 76 pp.

Pflieger, W.L. 1997. The Fishes of Missouri: Revised Edition. Missouri Department of Conservation, P.O. Box 180, Jefferson City, Missouri 65102. 372 pp.

Smale, M.A. and C.F. Rabeni. 1995. Hypoxia and Hyperthermia Tolerances of Headwater Stream Fishes. Transactions of the American Fisheries Society 124:698-710.

Simpson, K.W. and R.W. Bode. 1980. Common Larvae of Chironomidae (Diptera) from New York State Streams and Rivers with Particular Reference to the Fauna of Artificial Substrates. New York State Museum Bulletin. 439:1-105.

Sowa, S.P., D.D. Diamond, R.A. Abbitt, G.M. Annis, T. Gordon, M.E. Morey, G.R. Sorensen, and D. True. 2004. Final Report of the Aquatic Component of GAP Analysis: A Missouri Prototype. Missouri Resource Assessment Partnership (MoRAP), University of Missouri. 111 pp.

Sowa, S.P. and D.D. Diamond. 2006. Using GIS and an Aquatic Ecological Classification System to Classify and Map Distinct Riverine Ecosystems Throughout EPA Region 7. Missouri Resource Assessment Partnership (MoRAP), University of Missouri. 242 pp.

United States Environmental Protection Agency. 2000a. Ambient Water Quality Criteria Recommendations. Information Supporting the Development of State and Tribal Nutrient Criteria for River and Streams in Nutrient Ecoregion IX. United States Environmental Protection Agency, Office of Water, Washington, D.C., EPA-822-B-00-019. 32 pp.

United States Environmental Protection Agency. 2000b. Ambient Water Quality Criteria Recommendations. Information Supporting the Development of State and Tribal Nutrient Criteria for River and Streams in Nutrient Ecoregion XI. United States Environmental Protection Agency, Office of Water, Washington, D.C., EPA-822-B-00-020. 28 pp.

United States Environmental Protection Agency. 2006. North Fork Spring River, Jasper County, Missouri, Total Maximum Daily Load. U.S. Environmental Protection Agency, Region 7, Water Wetlands, and Pesticides Division. 13 pp.

Wiederholm, T. (Editor). 1983. Chironomidae of the Holarctic Region. Keys and Diagnoses. Part I. Larvae. Entomol. Scand. Suppl. 19:1-457.

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Appendix A

Missouri Department of Natural Resources
Dissolved Oxygen, Benthic Sediment, and Bioassessment Study Proposal
North Fork of the Spring River
Barton, Dade, and Jasper Counties
March 2, 2006

Missouri Department of Natural Resources
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Background

North Fork of the Spring River originates in western Dade County near the town of Golden City and is located within the Ozark/Elk/Spring Ecological Drainage Unit (EDU). North Fork of the Spring River is listed in the Missouri Water Quality Standards (MDNR 2005) as a class “C” stream for its first 51.5 miles, continuing as a class “P” stream for 14.5 miles to its confluence with the Spring River in Jasper County. Designated uses for North Fork of the Spring River are “warm water aquatic life protection, human health/fish consumption and livestock and wildlife watering.” The first 51.5 miles of the North Fork of the Spring River are included on the 2002 303(d) list with the impact designated as non-point agriculture related sediment.

The North Fork of the Spring River is a tributary of the Spring River system in southwestern Missouri that flows through an ecological transitional area that has features of both the Ozark and plains ecoregions. The stream system is characterized by long pools with short, rocky, and gravelly riffles and the geology in the watershed contains beds of shale, sandstone, and limestone (Pflieger, 1989). Stream sections of the North Fork of the Spring River that flow through the Ozark Highlands Ecoregion are transitional in nature while stream sections that flow through the Central Irregular Plains Ecoregion are prairie like in nature (Attachment B).

Streams subjected to increased sediment loading can be vulnerable to water quality and habitat degradations. Fertilizers and pesticides that adhere to soil particles, which are then flushed into waterways during storm events, can reduce water quality. Habitat loss can subsequently result from sediment clogging interstitial spaces in benthic structures that invertebrates use for foraging and protection. In extreme cases, sediment can affect the health of aquatic species by coating and irritating the gills of fish and invertebrates, by covering their nests and smothering eggs, and increasing the turbidity of the water thereby hindering the ability of sight feeders to forage. These potential factors have led to the placement of the North Fork of the Spring River on the 303(d) List of Impaired Waters.

A biological assessment study for the upper section of North Fork of the Spring River was completed in 2004 by the Field Services Division (**FSD**), Environmental Services Program (**ESP**), Water Quality Monitoring Section (**WQMS**) (MDNR 2004). Since there were no biological criteria reference streams in a transitional areas of the Ozark/Elk/Spring EDU, North Fork of the Spring River sampling stations were compared to biological criteria calculated from Horse and Cedar Creeks, two biological criteria reference streams in a transitional area of the Ozark/Osage EDU. The results of the study showed that Stream Condition Index (**SCI**) ratio of fully supporting to partially supporting macroinvertebrate communities for North Fork of the Spring River (9% / 91%) were below the acceptable ratio (80% / 15%) for biological reference streams in the Ozark/Osage EDU. These results indicated that the upper North Fork of the Spring River segment was impaired.

A biological assessment study for the lower section of North Fork of the Spring River was completed in 2005 by the Field Services Division (**FSD**), Environmental Services Program (**ESP**), Water Quality

Monitoring Section (**WQMS**) (MDNR 2005). Since some sampling locations were "plains like" in nature and some sampling locations were transitional in nature, leafpacks, a type of artificial substrate was used as a standardized habitat to assess the stream. To determine impairment of the North Fork of the Spring River, leafpacks were deployed at 5 stations on the North Fork of the Spring River and at control stations in the Osage River and the Arkansas River drainages. Control streams were Flat Rock Creek, a tributary of the Neosho River, located in Neosho County, Kansas and Little Drywood Creek, a Plains/Osage EDU biological criteria reference stream located in Vernon County, Missouri. The Kansas Department of Health and Environment recommended Flat Rock Creek as a control stream based on water quality data even though it is on the Kansas 303(d) list for copper. Seven biological metrics were used to determine impairment of the North Fork of the Spring River sampling stations. The results of the study showed that the three most upstream stations (test stations #3-#5) were impaired since four metrics showed differences from controls and station #2 showed slight impairment with two metrics showing differences. Station #1, the most downstream station, showed no impairment since none of the metrics showed differences from controls. The overall results indicated that most of the lower North Fork of the Spring River segment was impaired.

Objectives

In concordance with the MDNR Sediment TMDL Strategy, a stream listed for sediment, which does not meet the fully biological supporting criteria and has acceptable habitat, must be evaluated for water quality stressors. Therefore, we propose to conduct a re-assessment of the macroinvertebrate community of North Fork of the Spring River as well as an evaluation of channel morphology, dissolved oxygen and benthic sediment. Dissolved oxygen is added to sediment as a potential stressor due to low levels documented during the fall 2003 and 2004 sampling periods. Channel morphology measurements have relationships to channel modifications and water depths, which may have associations with sediment and dissolved oxygen.

Null Hypotheses

1. The macroinvertebrate assemblages will not differ among reaches of North Fork of the Spring River from upstream to downstream.
2. Dissolved oxygen will not differ among reaches of North Fork of the Spring River from upstream to downstream.
3. Benthic sediment deposits will not significantly differ among reaches of North Fork of the Spring River from upstream to downstream.
4. Channel width, depth and sinuosity measures will not differ among reaches of North Fork of the Spring River from upstream to downstream.
5. The macroinvertebrate assemblage of North Fork of the Spring River at transitional sampling stations where all four habitats are available (CS, NF, SG, and RM), will not differ from that found in Cedar and Horse creeks, two biological criteria reference streams in a transitional area of the Ozark/Osage EDU or Little Drywood Creek, a biological criteria stream in the Plains/Osage EDU.
6. The macroinvertebrate assemblage of North Fork of the Spring River at sampling stations located in the prairie ecoregion will not differ from that found in Little Drywood Creek, a biological criteria reference stream in the Plains/Osage EDU.
7. The dissolved oxygen of North Fork of the Spring River will not differ from that found in Cedar and Horse creeks, two biological criteria reference streams in a transitional area of the Ozark/Osage EDU and Little Drywood Creek, a biological criteria reference stream in the Plains/Osage EDU.
8. The benthic sediment deposits of North Fork of the Spring River will not significantly differ from that found in Cedar and Horse creeks, two biological criteria reference streams in a transitional area of the

Ozark/Osage EDU and Little Drywood Creek, a biological criteria reference stream in the Plains/Osage EDU.

9. The channel width, depth and sinuosity of North Fork of the Spring River will not differ from that found in Cedar and Horse creeks, two biological criteria reference streams in a transitional area of the Ozark/Osage EDU and Little Drywood Creek, a biological criteria reference stream in the Plains/Osage EDU.

Study Design

General: The North Fork of the Spring River study area is included entirely within the approximately 51.5 mile 303(d) listed reach of North Fork of the Spring River. The upstream boundary of the North Fork of the Spring River study area is just upstream of Golden City in Dade county and the downstream boundary is the approximate confluence of Dry Fork Creek located southeast of Jasper, in Jasper county. A total of 10 North Fork of the Spring River stations will be surveyed (see Attachment C for map). The general locations are listed in Table 1 beginning with the most downstream site.

Table 1
North Fork of the Spring River Sample Locations

Sample Site	Geographic Location
North Fork Spring River #1	SE ¼ sec. 29, T. 30 N., R. 31 W.
North Fork Spring River #2	SW ¼ sec. 11, T. 30 N., R. 31 W.
North Fork Spring River #3	SW ¼ sec. 26, T. 31 N., R. 31 W.
North Fork Spring River #4	SE ¼ sec. 1, T. 31 N., R. 31 W.
North Fork Spring River #5	SW ¼ sec. 25, T. 32 N., R. 31 W.
North Fork Spring River #6	NW ¼, sec. 24, T. 32 N., R. 31 W.
North Fork Spring River #7	NE ¼, sec. 31, T. 32 N., R. 29 W.
North Fork Spring River #8	NE ¼, sec. 9, T. 31 N., R. 29 W.
North Fork Spring River #9	SE ¼, sec. 23, T. 31 N., R. 29 W.
North Fork Spring River #10	SW ¼, sec. 36, T. 31 N., R. 29 W.

North Fork of the Spring River is in the Ozark/Elk/Spring EDU. Biological, chemical, and habitat comparisons will be made between the ten (10) sampling stations on North Fork of the Spring River, one (1) sampling station on Cedar Creek, one (1) sampling station on Horse Creek, and one (1) sampling station on Little Drywood Creek.

Biological Sampling: Macroinvertebrates will be sampled according to the methods described in the Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure (**SMSBPP**) (2003d). All habitats for riffle/run and glide/pool streams (CS, NF, SG, RM) will be collected on North Fork of the Spring River sampling stations located in transitional stream segments and glide/pool habitats (NF, SG, RM) habitats will be collected at sampling stations in plains stream segments. Sampling will be conducted during fall 2006 (September 15 through October 15) and spring 2007 (March15 through April 15). Macroinvertebrate samples will be a composite of six 1-m^2 kick samples within coarse substrate (transitional stream segments only), six 1-m^2 kick samples within non-flow habitat (NF), 6 lineal meters of rootmat habitat, and 400 cm^2 from each of 12 pieces of woody debris in varying stages of decomposition.

Water Quality Sampling: Water chemistry analyses will be restricted to field measurements of dissolved oxygen and water samples for turbidity and total suspended sediment (**TSS**), which will be returned and analyzed at the ESP laboratory. The samples will be collected per the standard operating procedures: Required/Recommended Containers, Volumes, Preservatives, Holding Times, and Special Considerations, MDNR-FSS-001 (MDNR 2003c) and Field Sheet and Chain-of-Custody Record, MDNR-FSS-002 (MDNR 2005a). Field measurements of dissolved oxygen will be measured per the standard operating procedures: Sample Collection and Field Analysis for Dissolved Oxygen Using a Membrane Electrode Meter, MDNR-WQMS-103 (MDNR 2002) and Continuous or Long Term Monitoring of Water Quality Using a Dissolved Oxygen and Temperature Data Logger, MDNR-WQMS-104 (MDNR 2003a).

Dissolved oxygen will be measured during a 1-month period previous to macroinvertebrate sampling in the fall (August 15 through September 15). Discrete measurements shall be taken at all sampling stations for 3 days per early morning recommendations in the Wasteload Allocation/Special Stream Studies Project Procedure (MDNR 2003e). Dissolved oxygen data loggers will be deployed at two (2) North Fork of the Spring River stations, one (1) Cedar Creek station, one (1) at Horse Creek station, and one (1) Little Drywood Creek station for a minimum of 3 days and a maximum of 7 days.

Turbidity and TSS samples will be collected from each sampling station once during the time period for dissolved oxygen measurements and once during the time period for macroinvertebrate sampling. Stream discharge measurements also will be taken at the time of sample collection using a Marsh-McBirney flow meter per MDNR-FSS-113 (MDNR 2003b).

Draft Benthic Sediment Sampling: Benthic sediment will be measured once during the summer or fall low flow period at all sampling stations. See Attachment A for sampling method.

Channel Morphology Measurements: The ESP has selected stream reach and channel measurements that tend to represent undesirable changes in channel morphology due to channel modifications. Those measurements are Average Channel Width, Average Wetted Channel Width, Ratio of Channel Width to Wetted Width, Average Depth, Ratio of Wetted Width to Depth, Drainage Size, Sinuosity, the Standard Deviation of Depth, and Maximum Depth.

At each sampling station a series of 10 bank to bank transects will be established. Each transect is equally spaced within the sampling reach. Each spacing is equivalent to 20x the average width. Channel measurements are taken at each transect. These measurements included lower bank width, wetted width, and water depth at ¼, ½, and ¾ of the distance across the wetted width. In order to document critical habitat conditions, measurements will be collected once during the fall low flow period.

Laboratory Methods: All water quality samples will be analyzed at the MDNR ESP laboratory. The samples of macroinvertebrates will be processed (MDNR 2003d) and identified per the standard operating procedure Taxonomic Levels for Macroinvertebrate Identification, MDNR-FSS-209 (MDNR 2005b).

Data Recording and Analyses: Macroinvertebrate data will be entered in a Microsoft Access database in accordance with Quality Control Procedures for Data Processing, MDNR-WQMS-214 (MDNR 2003f). Data analysis is automated within the Access database. Two separate analyses will be conducted. The first analysis will be using the standard multi-habitat approach where four standard metrics will be calculated for each sample reach according to the SMSBPP: Taxa Richness (TR); Ephemeroptera, Plecoptera, Trichoptera Taxa (EPTT); Biotic Index (BI); and the Shannon Diversity Index (SDI). Additional metrics,

such as Quantitative Similarity Index for Taxa (QSI-T) may be used to discern differences in taxa between control and impacted stations. This method will be used to determine overall habitat quality of the sampling stations. It will also help determine if the macroinvertebrate community on North Fork of the Spring River is more similar to Cedar and Horse creeks, two biological criteria reference streams in a transitional area of the Ozark/Osage EDU or Little Drywood Creek, a biological criteria reference stream in the Plains/Osage EDU.

The second analysis is to assess the sampling stations using NF data only. This analysis is being done since benthic sedimentation occurs primarily in this stream habitat and all sampling locations will have the habitat in common. Some of the standard metrics, like BI and EPT, included in the SMSBPP may be used in the analyses along with other metrics like percent tolerant taxa, percent sediment tolerant taxa, and percent EPT that would indicate the impacts of sedimentation or low dissolved oxygen. Macroinvertebrate metric data will then be correlated with sediment and dissolved oxygen to attempt to determine primary sources of impairment.

Ordination of macroinvertebrate data may be performed and regression analysis used to examine potential associations with water chemistry and habitat data. Benthic sediment, channel morphology and water quality data also will be used to help interpret macroinvertebrate data.

Water quality data will be entered in the Laboratory Information Management System (LIMS) database. Data analysis will be summarized and interpreted using Microsoft Access and Excel software as well as Jandel Scientific software, SigmaStat.

Data Reporting: Results of the study will be summarized and interpreted in report format.

Quality Control: As stated in the various MDNR Project Procedures and Standard Operating Procedures.

Literature Cited

Missouri Department of Natural Resources. 2002. Sample Collection and Field Analysis for Dissolved Oxygen Using a Membrane Electrode Meter. Field Services Division, Environmental Services Program. Water Quality Monitoring Section, P.O. Box 176, Jefferson City, Missouri, 65102. 13 pp.

Missouri Department of Natural Resources. 2003a. Continuous or Long Term Monitoring of Water Quality Using a Dissolved Oxygen and Temperature Data Logger. Field Services Division, Environmental Services Program. Water Quality Monitoring Section, P.O. Box 176, Jefferson City, Missouri, 65102. 25 pp.

Missouri Department of Natural Resources. 2003b. Flow Measurements in Open Channels. Field Services Division, Environmental Services Program. Water Quality Monitoring Section, P.O. Box 176, Jefferson City, Missouri, 65102. 9 pp.

Missouri Department of Natural Resources. 2003c. Required/Recommended Containers, Volumes, Preservatives, Holding Times, and Special Considerations. Field Services Division, Environmental Services Program. Water Quality Monitoring Section, P.O. Box 176, Jefferson City, Missouri, 65102. 21 pp.

Missouri Department of Natural Resources. 2003d. Semi-Quantitative Macroinvertebrate Stream Bioassessment Project Procedure. Field Services Division, Environmental Services Program. Water Quality Monitoring Section, P.O. Box 176, Jefferson City, Missouri, 65102. 24 pp.

Missouri Department of Natural Resources. 2003e. Wasteload Allocation/Special Stream Studies Project Procedure. Field Services Division, Environmental Services Program. Water Quality Monitoring Section, P.O. Box 176, Jefferson City, Missouri, 65102. 9 pp.

Missouri Department of Natural Resources. 2003f. Quality Control Procedures for Data Processing. Field Services Division, Environmental Services Program. Water Quality Monitoring Section, P.O. Box 176, Jefferson City, Missouri, 65102. 6 pp.

Missouri Department of Natural Resources. 2004. Biological Assessment Study, Upper North Fork of the Spring River, Dade and Barton Counties. Field Services Division, Environmental Services Program. Water Quality Monitoring Section, P.O. Box 176, Jefferson City, Missouri, 65102. 34 pp.

Missouri Department of Natural Resources. 2005a. Field Sheet and Chain-of-Custody Record. Field Services Division, Environmental Services Program. Water Quality Monitoring Section, P.O. Box 176, Jefferson City, Missouri, 65102. 8 pp.

Missouri Department of Natural Resources. 2005b. Taxonomic Levels for Macroinvertebrate Identification. Field Services Division, Environmental Services Program. Water Quality Monitoring Section, P.O. Box 176, Jefferson City, Missouri, 65102. 30pp.

Missouri Department of Natural Resources. 2005c. Biological Assessment Study, Lower North Fork of the Spring River, Barton and Jasper Counties. Field Services Division, Environmental Services Program. Water Quality Monitoring Section, P.O. Box 176, Jefferson City, Missouri, 65102. 32 pp.

Pflieger, W.L. 1989. Aquatic Community Classification System for Missouri. Missouri Department of Conservation Aquatic Series No. 19. 76 pp.

Attachments

Attachment A: Draft Benthic Sediment Sampling Method
Attachment B: Level III Ecoregion Map
Attachment C: North Fork of the Spring River Sampling Stations Map

Attachment A

Draft Benthic Sediment Procedure

Sediment should increase from upstream to downstream due to naturally occurring events such as bank and streambed erosion and runoff from tributaries experiencing bank and streambed erosion. When human disturbance takes place in a watershed (increased impervious area, increased magnitudes during flood events, removal of vegetation from land in the watershed, channel modification, etc.) the amount of sediment available for transport in a stream should increase through increased erosion rates. Given similar watershed characteristics (geology, land cover, etc.) two streams should contain (in their bed-loads) similar quantities and types of sediment (sand and silt).

Potential Study Questions

Are the amounts of sediment (silt + sand), only silt, and only sand, increasing from upstream to downstream in the test stream by an amount similar to the control stream?

Are the amounts of sediment (silt + sand), only silt, and only sand, different between the test stream and control stream? Are they higher or lower?

Procedures

Multiple stations along a longitudinal gradient should be sampled. Stations can also bracket locations that could possibly contribute to increased sediment inputs to a test stream. Upstream and downstream coordinates should be collected using handheld Global Positioning System units.

Benthic Sediment Sampling Device

At each station 10 to 20 random transect composite samples will be collected in the most representative pool in the sample reach. Each sample will be a composite of four grabs taken from a transect. The grabs will be collected using a device created by the Water Quality Monitoring Section (Figure 1). The device is composed of two main parts, the handle and sample cup assembly and the outer casing, which slide vertically and independently of each other. The handle and sample cup assembly is composed of a threaded rod approximately 36 inches long with a wooden handle attached to the top and a PVC sample cup, oriented with the opening upwards, attached to the bottom. The exposed portions of threaded rod, not covered by the handle or the sample cup, are covered with rubber tubing to reduce friction when sliding vertically through the casing and to minimize any water that may splash upward through the casing assembly. The inside dimensions of the sample cup are 3¼ inches diameter by 1½ inches tall. This yields a volume of approximately 12.44 in^3. The outer casing is composed of a 6 inch long piece of 4 inch inner diameter (ID) PVC attached to a 24 inch long piece of ¾ inch ID PVC in which the handle and sample cup assembly can slide vertically. At the top of the 4 inch ID PVC, and on the inside, is a rubber seal to help contain the sample until it can be emptied into the collection container.

Each grab sample is obtained in the following manner. First, the handle/sample cup assembly is slid upwards until the sample cup contacts the rubber seal. Then, the device is lowered into the

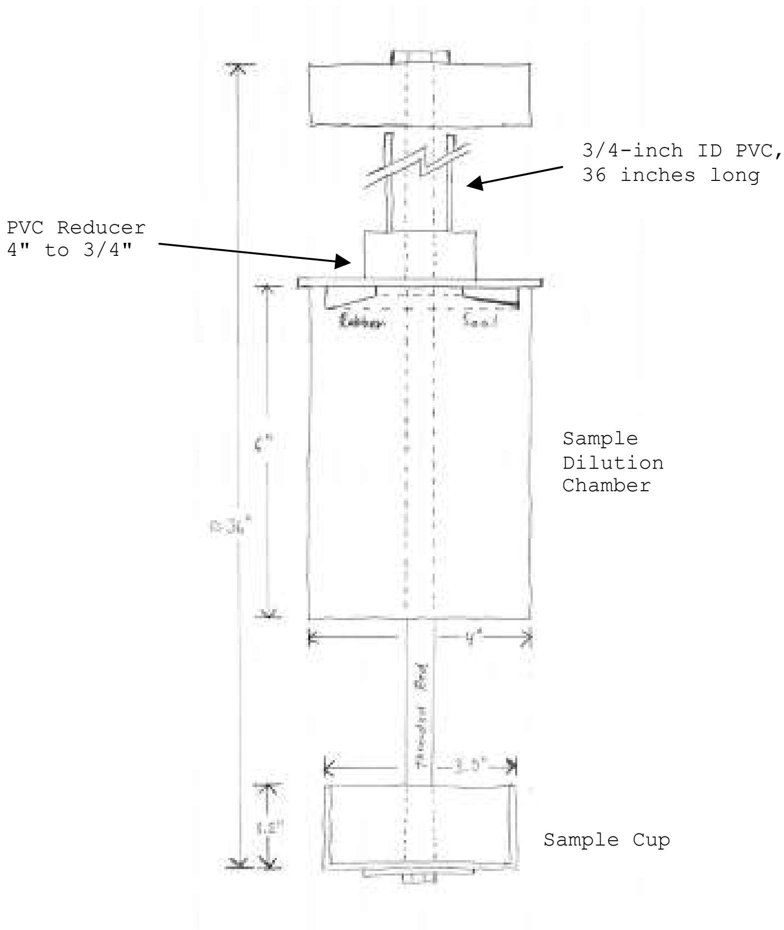


Figure 1

water until it contacts the stream bottom taking care to ensure the best seal possible between the PVC casing and the stream bottom. The depth of water must be at least six inches to ensure that the entire section of 4-inch ID PVC is filled with water. The handle and sample cup assembly are then pushed downward until the sample cup contacts the stream bottom, and then pulled upward until the sample cup contacts the rubber seal again in one motion. This is done five times, taking approximately 1 second each, resulting in the mixing of sediment on the stream bottom with the water trapped in the 4 inch ID PVC casing sample chamber.

After the fifth time water and sediment are trapped in the sample cup by exerting upward pressure on the handle. The device is removed from the water making sure the device is kept vertical with the handle at the top and the sample cup at the bottom to maintain a sealed sample. The sample cup is then gently lowered to its lowest extent and removed by holding the sample cup stationary and turning the handle counter-clockwise. This results in the sample cup being unscrewed from the threaded rod. This is best accomplished by two people to minimize spillage from the sample cup. The contents of the sample cup are then poured into a collection container, which, for the purposes of this study, will be a one-quart glass or plastic container. Any remaining sediment should be gently washed from the sample cup into the collection container with deionized water.

Sample Collection

As mentioned above, ten to twenty composite samples will be collected at each sample station. A composite sample will consist of four grab samples collected at each transect. The sampling will conducted at the most representative pool within the sample reach where the water depth ranges from 6 inches to 3 feet and with a stream velocity no greater than 0.5 cfs. The first step in determining the random transects at each sample station is to determine the part of the pool that will be sampled. This will be 50 feet in both directions from the middle of the pool. A 100-foot tape will be strung along one of the stream banks with each foot marker representing a possible random transect location. A random numbers table will be used to determine the ten to twenty random transects that will be sampled. At each transect a tape measure will be stretched over the width of the stream, including eddies or pools connected to the stream on the backside of point bars. Four grab samples are to be collected at each transect resulting in a composite sample. The outer points of the tape measure where the water reaches six inches deep will be noted (Figure 2). These are the two outer grab sample points. If the water is too shallow to establish the outer points or the distance between the two points will not allow the collection of four grab samples the transect shall be moved upstream until a suitable transect can be established.

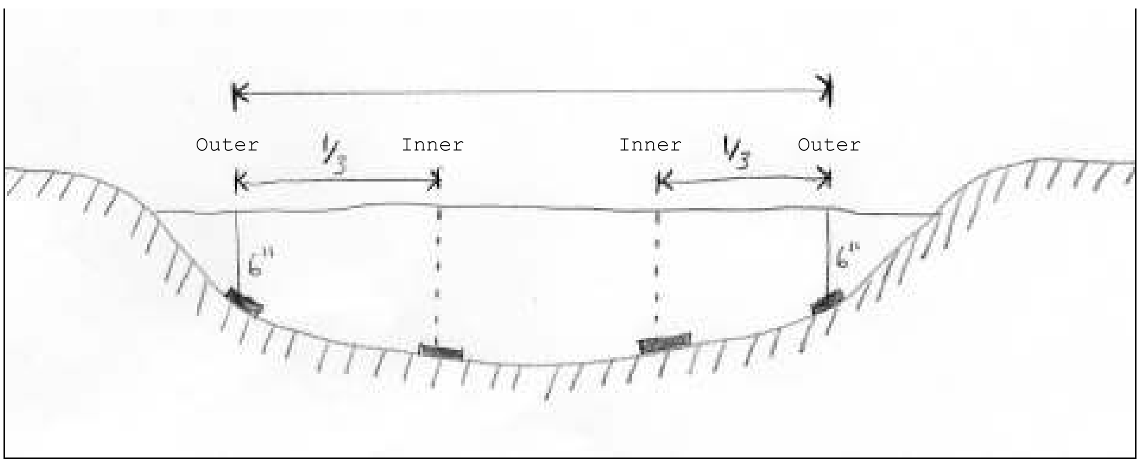


Figure 2

A suitable transect must be at least 6-inches deep and wide enough over that depth to collect four grab samples (16 inches wide). If the water is deep enough, the remaining distance between the two outer points will be divided into thirds (Figure 2). The distance to each third will be noted along with the two points where the water reaches six inches deep. These are the two inner grab sample points. If either of the "inner" points lies on an isolated obstruction (boulder, log, etc.) that is submerged or partially submerged, leaving less than six inches of water, (Figure 3) the transect will be moved upstream to a point where the obstruction does not interfere with the survey. If either of the "inner" points lies on a point bar above the water level (Figure 4, Point A), or on the slope of a point bar in water less than six inches deep (Figure 4, Point B), the following will occur:

1. Find a location, moving towards the nearest "outer" point where the water is at least six inches deep (Figure 4, Point C).

2. Measure the distance between this new point and the nearest "outer" point.
3. Move one-third this distance toward the "outer" point (Figure 4, Point D).
4. This will be the new "inner" point.

At this time there should be four grab sample points established. Using the sampler, gather sediment sample from each point and composite them in a sample container. When all twenty transects have been completed there will be 20 samples per site, which have been collected from 120 individual benthic locations.

Additional information recorded at each transect includes: width between outer sampling points; and, general observation of bank conditions (i.e. denuded, vegetated, slumping, etc). Discharge will be surveyed at each sampling site.

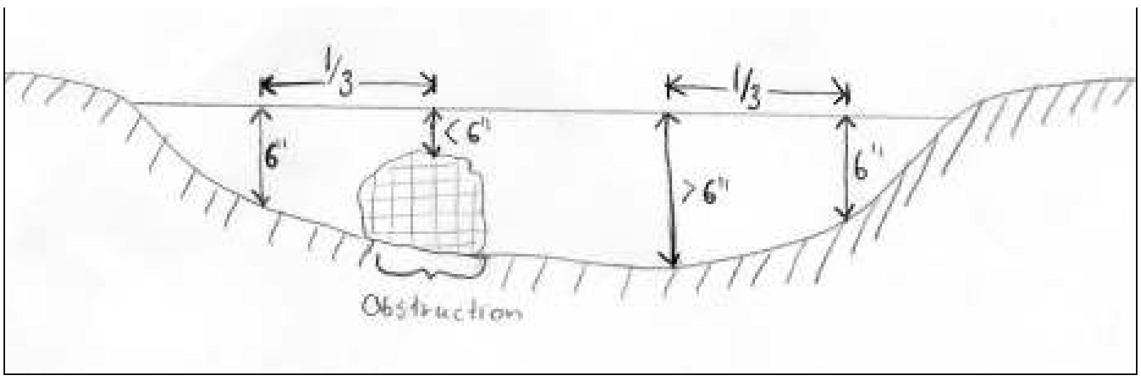


Figure 3

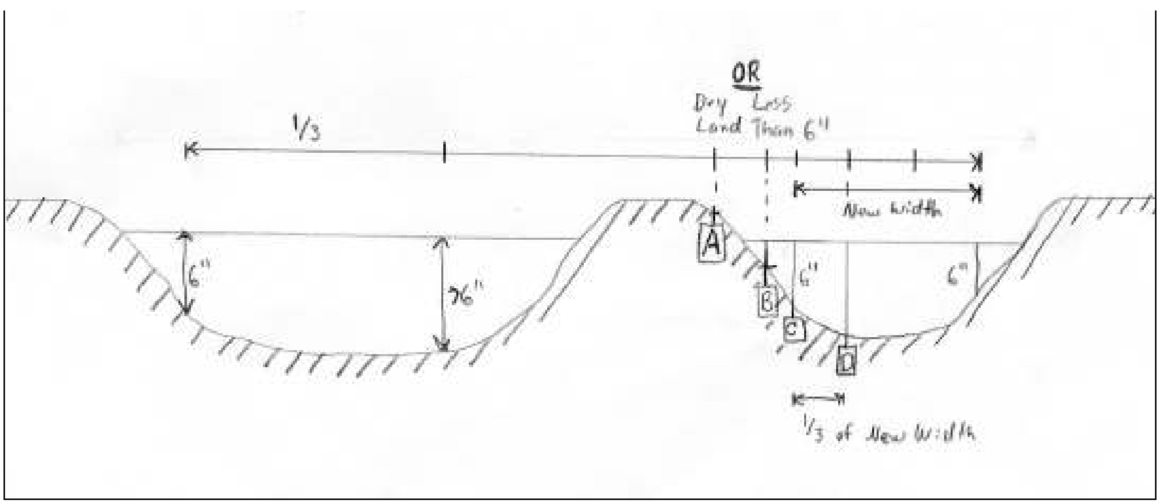


Figure 4

Settling Tube Sample Analysis

Modifying the Bouyocos Soil Texture Method for Sediment Analysis

The determination of soil texture is called: 1) particle size analysis or 2) mechanical analysis**.** Determining the texture in the laboratory uses a basic principle of sedimentation called "Stokes Law". Stokes Law states that the speed or velocity with which particles settle out of a liquid medium is dependent on a constant factor (K) and the radius of the particles. Or, the bigger the particle, the faster it will fall out of suspension. K is composed of the factors:
g = acceleration of gravity
$d1$ = density of particle
$d2$ = density of liquid
μ = viscosity of liquid
v = velocity
$v = Kr^2$, and $K = 2g(d1-d2) \div \mu$

An approximation of the formula is v (cm/sec) = $8711d^2$ (cm)

The same method that is used for soil analysis can be used on sediment found in streams and rivers. Major sediment fractions of concern are sands and silts. Both can cause the loss of interstitial spaces in gravel and cobble bottom streams or change the benthic deposits composition of streams with naturally finer materials making up the streambed. The Bouyocos method is useful in separating coarse through fine sand from very fine sands through silt. The Wentworth soil particle scale is useful in defining the diameters of these particles. The upper limit for sand is a diameter of 0.2 cm and the lower limit for fine sand is 0.0125 cm. The upper limit for very fine sand is <0.0125 cm.

The standard Bouyocos method uses a Hydrometer jar (ASTM D-422). The jar is a glass cylinder with dimensions of 6.4 cm outside diameter by 45.7 cm vertical distance to a calibrated white line which is the beginning point of measurement. The basic principal applied is the settling velocity of particular diameter particles. The initial reading is taken with a hydrometer at 40 seconds with a secondary reading at 2 hours. The 40 second reading is the time which most particles of fine sand (>0.0125 cm) have reached the bottom. The 2-hour reading the time at which most silt particles (0.0124 – 0.0004 cm) have reached the bottom. Any material in suspension after two hours is considered the clay fraction.

The modified method uses a different tube length and direct sediment measurement instead of hydrometer readings. The sedimentation tubes are 6 cm outside diameter by 60 cm long clear PVC plastic tubes with PVC plugs in one end. The calibration mark is at 55.5 cm. If the 45.7 cm hydrometer jar's first reading is made at 40 seconds then the 55.5 cm settling tubes can be algebraically solved for the adjusted first reading. The adjusted time for a longer settling distance at the first reading is approximately 48 seconds.

Sediment Analyses Method

The samples will be refrigerated and allowed to settle at least two hours or until a sample can be analyzed. There is no holding time for these samples, although they should be refrigerated. Prior to analysis each sample will be allowed to sit at least two hours to warm up to room temperature. Each sample will be analyzed in the lab using Settling Tube analysis as follows.

Assuming the sample has been allowed to settle at least two hours, any free water in the container can be poured off gently not allowing any settled sediment to be released from the container. The remaining sediment and water are transferred to a 24-inch long piece of 2-inch ID clear PVC through a 2-millimeter filter to exclude particles greater than 2 millimeter. The PVC is capped at the bottom to contain the sample in the pipe. The PVC should then be filled with water to exactly 2 inches from the top, which allows a small amount of air space. The PVC is then temporarily capped with a rubber stopper and inverted five times, allowing the bubble to move entirely from one end to the other, mixing the sediment and water completely.

After the fifth time the tube is set into the analysis rack and a stopwatch is started immediately. After 45 seconds the depth of sediment in the tube is measured from the bottom of the tube to the top of the settled sediment. This is done with a flat metal ruler graduated in millimeters. Forty-five seconds is the amount of time for most sand particles to settle out and shall be referred to as the "45 second reading." The depth is recorded on the standard data sheet (see attachment A).

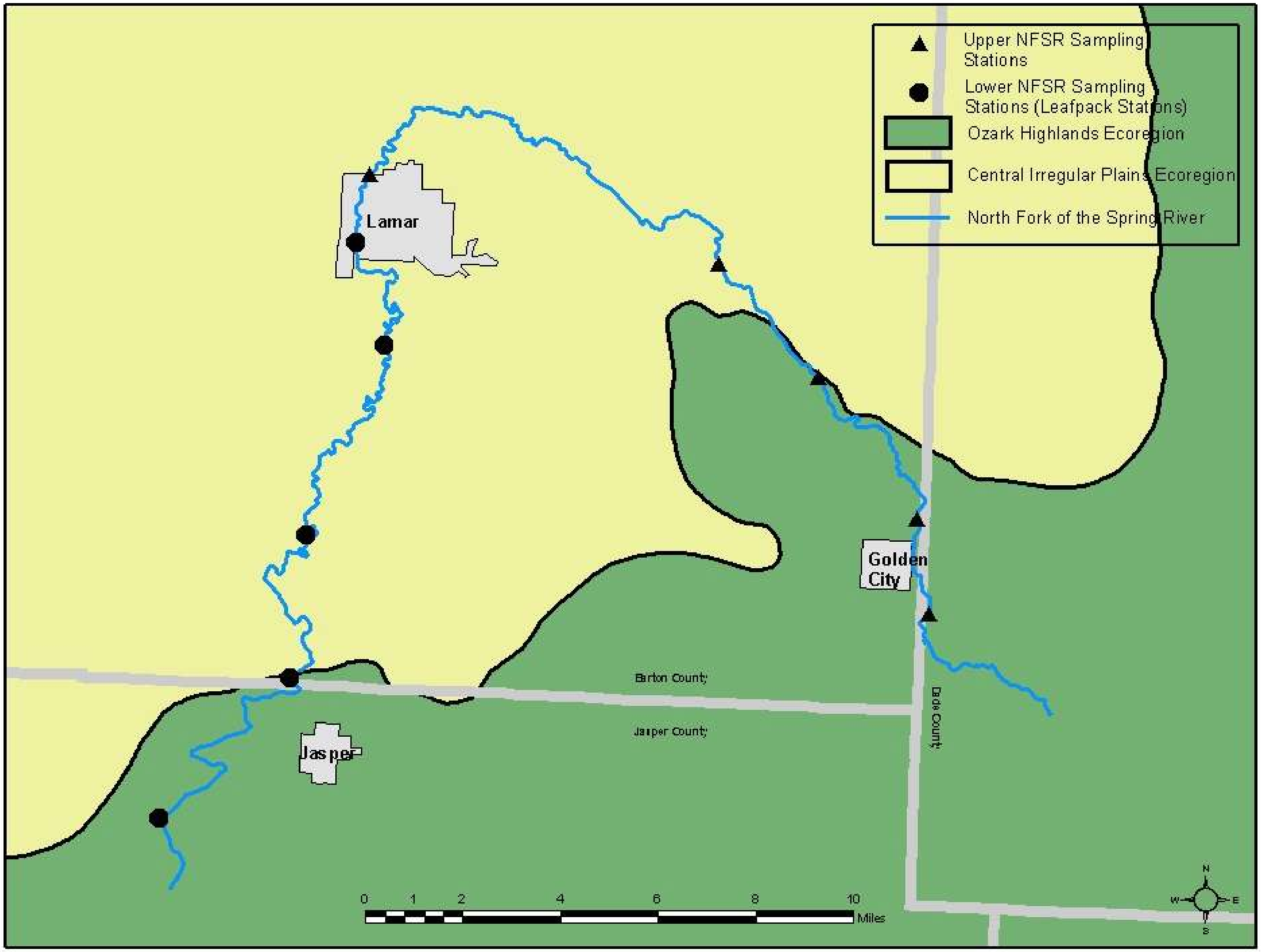
The sediment is then allowed to settle for two hours. At that time two sets of measurements are taken. The first measurement is the total amount of settled sediment and is measured like the "45 second reading." The second measurement is an approximation of the interface between the coarse sand and finer particles. This interface is approximately equal to the depth of sediment recorded after 45 seconds, and should be readily apparent. If it is not apparent, the analyst should measure the approximate interface between sand and finer particles, if that interface exists. If the sample is composed entirely of sand (no apparent interface) the entire depth is measured. If the sample is composed entirely of finer particles (the 45 second reading reveals no settled sediment) the interface reading is zero. The tube must then be turned 180 degrees and both readings taken again as above. This will result in two sets of readings: two readings of total sediment and two readings of the sand/finer particle interface. Each set of readings is averaged to result in a final reading (see Attachment A). The sand/finer particle interface reading is subtracted from the total sediment reading to result in the amount of finer particles (fine sand and silt). Five samples can be analyzed at the same time using the sediment tube rack (Figure 3).

Figure 5

Data Analysis and Final Reporting

Data will be analyzed for differences between test stream and control stream for changes in amounts of sediment from upstream to downstream and differences in amounts of sediment between streams. These differences will include only sand, only silt and silt and sand combined. For the first objective the changes in amounts of sediment from upstream to downstream, between each station, will be calculated. These differences will be compared to the control stream using box plots and Analysis of Variance to detect significant differences. For the second objective, raw measurements of amounts of sediment for each station will be compared to the stations at the control stream for significant differences using box plots and Analysis of Variance.

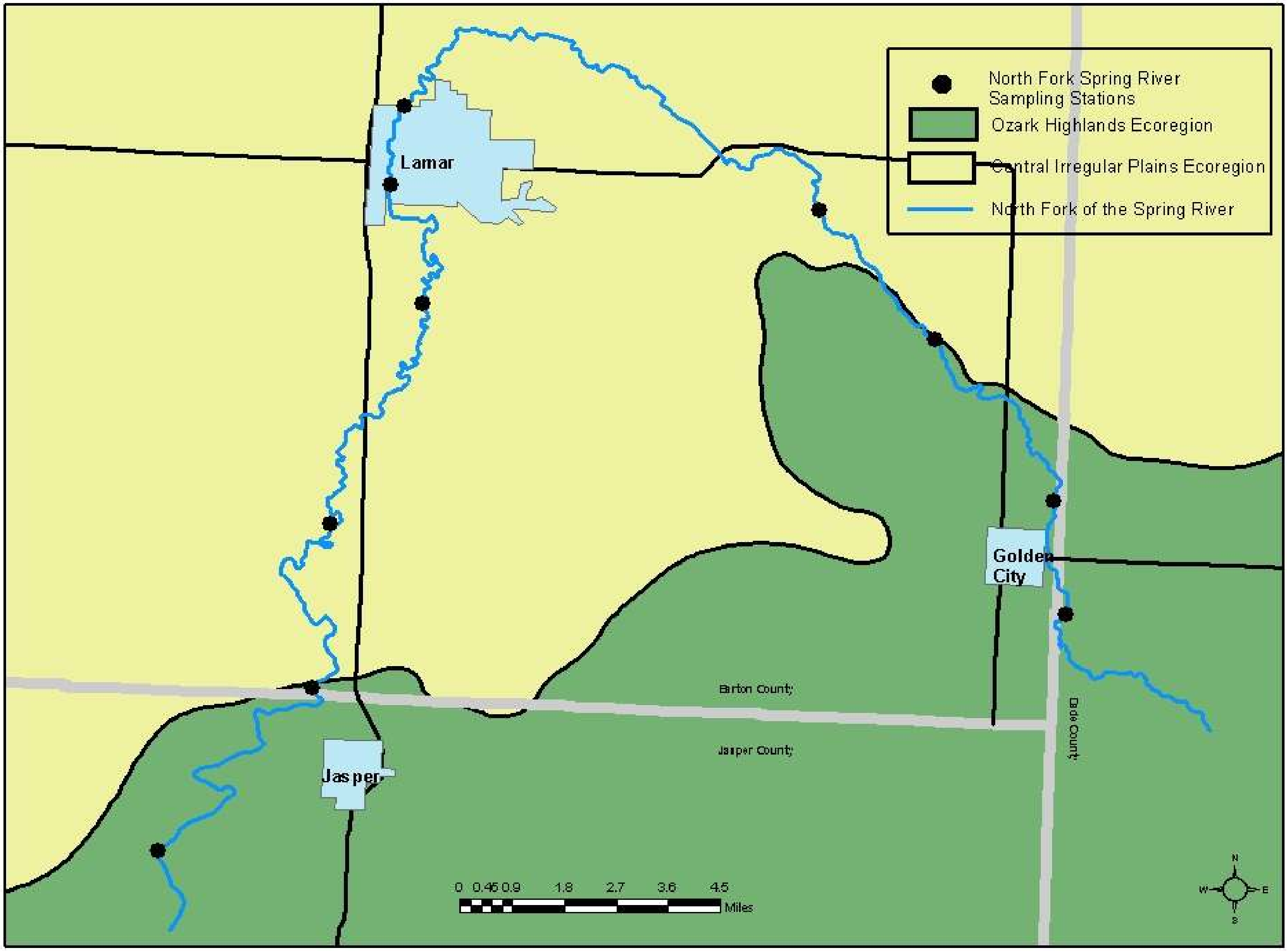
Attachment B
Level III Ecoregion Map Showing Sampling Stations for the Upper North Fork of the Spring River Bioassessment Study Using Biological Criteria Protocols and the Lower North Fork of the Spring River Study Using Leafpacks



Upper NFSR Sampling Stations
Lower NFSR Sampling Stations (Leafpack Stations)
Ozark Highlands Ecoregion
Central Irregular Plains Ecoregion
North Fork of the Spring River
Lamar
Golden City
Jasper
Barton County
Jasper County
Dade County
0 1 2 4 6 8 10
Miles
N
W
E
S

Attachment C

Map of the Proposed Stations for the North Fork of the Spring River Stressor Study



North Fork Spring River Sampling Stations
Ozark Highlands Ecoregion
Central Irregular Plains Ecoregion
North Fork of the Spring River
Lamar
Golden City
Jasper
Barton County
Jasper County
Dade County
0 0.45 0.9 1.8 2.7 3.6 4.5
Miles
N
E
S
W

Appendix B

Detrended Correspondence Analysis (DCA) Comparing the Macroinvertebrate Samples at the NFSR Test Stations to Macroinvertebrate Samples Collected Previously at Sampling Stations Located Within the Biological Criteria Reference Reaches of Cedar Creek, Horse Creek, and Little Drywood Creek. Both Sampling Regimes (R/P and G/P) Were Included in the Analysis at NFSR Stations That All Four Habitats (CS, NF, SG, and RM) Were Collected.

```
****************** Detrended Correspondence Analysis (DCA) ******************
PC-ORD, Version 4.14
19 Feb 2008, 15:01

Fall 2006 (All Available Habitats)
Number of non-zero data items:     2201

No downweighting
Axes are rescaled
Number of segments: 30
Threshold:  0.00



Total variance ("inertia") in the species data:   2.4932


                    ---------- Axis 1 ----------

 0.1317335814 = residual at iteration   0
 0.0056071635 = residual at iteration   1
 0.0000592805 = residual at iteration   2
 0.0000006842 = residual at iteration   3
 0.0000001661 = residual at iteration   4
 0.1412458718 = residual at iteration   5
 0.0064791013 = residual at iteration   6
 0.0000913515 = residual at iteration   7
 0.0000014881 = residual at iteration   8
 0.0000001374 = residual at iteration   9
 0.1582570970 = residual at iteration  10
 0.0009212453 = residual at iteration  11
 0.0000113718 = residual at iteration  12
 0.0000002260 = residual at iteration  13
 0.0670801923 = residual at iteration  14
 0.0168095194 = residual at iteration  15
 0.0001970210 = residual at iteration  16
 0.0000032708 = residual at iteration  17
 0.0000001110 = residual at iteration  18
 0.0775565132 = residual at iteration  19
```

```
 0.0142319938 = residual at iteration  20
 0.0001858305 = residual at iteration  21
 0.0000029883 = residual at iteration  22
 0.0000001091 = residual at iteration  23
 0.0501183905 = residual at iteration  24
 0.0192011911 = residual at iteration  25
 0.0002347092 = residual at iteration  26
 0.0000034272 = residual at iteration  27
 0.0000001110 = residual at iteration  28
 0.0730281919 = residual at iteration  29
 0.0154840872 = residual at iteration  30
 0.0001574985 = residual at iteration  31
 0.0000023527 = residual at iteration  32
 0.0000001269 = residual at iteration  33
 0.1294083744 = residual at iteration  34
 0.0050995639 = residual at iteration  35
 0.0000631557 = residual at iteration  36
 0.0000008514 = residual at iteration  37
 0.0000000727 = residual at iteration  38
 0.4610155821 = eigen value


Length of gradient:     2.456
Length of segments:  0.29  0.28  0.27  0.25  0.22  0.19  0.17  0.15  0.15  0.14
Length of segments:  0.12  0.12  0.11
Length of gradient:     2.777


Length of gradient:     2.822
Length of segments:  0.20  0.20  0.19  0.19  0.19  0.19  0.19  0.19  0.19  0.19
Length of segments:  0.18  0.18  0.18  0.18  0.18
Length of gradient:     2.818


                   ---------- Axis 2 ----------

 0.0479164049 = residual at iteration   0
 0.0290855486 = residual at iteration   1
 0.0032055830 = residual at iteration   2
 0.0003707186 = residual at iteration   3
 0.0000418475 = residual at iteration   4
```

```
0.0000052485 = residual at iteration   5
0.0000006248 = residual at iteration   6
0.0000001879 = residual at iteration   7
0.0567194633 = residual at iteration   8
0.0059293695 = residual at iteration   9
0.0005238388 = residual at iteration  10
0.0000402118 = residual at iteration  11
0.0000043162 = residual at iteration  12
0.0000003807 = residual at iteration  13
0.0000001418 = residual at iteration  14
0.0551047251 = residual at iteration  15
0.0125648631 = residual at iteration  16
0.0011541806 = residual at iteration  17
0.0001379357 = residual at iteration  18
0.0000161858 = residual at iteration  19
0.0000020338 = residual at iteration  20
0.0000002628 = residual at iteration  21
0.0343474932 = residual at iteration  22
0.0147247100 = residual at iteration  23
0.0010050191 = residual at iteration  24
0.0001187461 = residual at iteration  25
0.0000088671 = residual at iteration  26
0.0000011417 = residual at iteration  27
0.0000001453 = residual at iteration  28
0.0374105461 = residual at iteration  29
0.0231388044 = residual at iteration  30
0.0019790300 = residual at iteration  31
0.0002540952 = residual at iteration  32
0.0000286447 = residual at iteration  33
0.0000038940 = residual at iteration  34
0.0000004540 = residual at iteration  35
0.0000002592 = residual at iteration  36
0.0000002499 = residual at iteration  37
0.0498280376 = residual at iteration  38
0.0040659481 = residual at iteration  39
0.0002132187 = residual at iteration  40
0.0000087175 = residual at iteration  41
0.0000008202 = residual at iteration  42
0.0000001924 = residual at iteration  43
0.0453810468 = residual at iteration  44
0.0040647965 = residual at iteration  45
```

```
0.0004287091 = residual at iteration  46
0.0000270694 = residual at iteration  47
0.0000033277 = residual at iteration  48
0.0000002787 = residual at iteration  49
0.0276603326 = residual at iteration  50
0.0043790503 = residual at iteration  60
0.0000078966 = residual at iteration  70
0.0552215539 = residual at iteration  80
0.0000399619 = residual at iteration  90
0.0328519568 = residual at iteration 100
0.0004415835 = residual at iteration 110
0.0000001347 = residual at iteration 120
0.0042935708 = residual at iteration 130
0.0000486368 = residual at iteration 140
0.0000003289 = residual at iteration 150
0.0339661501 = residual at iteration 160
0.0000449044 = residual at iteration 170
0.0295525528 = residual at iteration 180
0.0014971028 = residual at iteration 190
0.0000086308 = residual at iteration 200
0.0339725800 = residual at iteration 210
0.0052592391 = residual at iteration 220
0.0000024248 = residual at iteration 230
0.0000008794 = residual at iteration 240
0.0045266431 = residual at iteration 250
0.0000297590 = residual at iteration 260
0.0321599580 = residual at iteration 270
0.0001216003 = residual at iteration 280
0.0000003350 = residual at iteration 290
0.0031599023 = residual at iteration 300
0.0000043698 = residual at iteration 310
0.0298461411 = residual at iteration 320
0.0000196374 = residual at iteration 330
0.0000003647 = residual at iteration 340
0.0028482242 = residual at iteration 350
0.0000039860 = residual at iteration 360
0.0263696089 = residual at iteration 370
0.0000232735 = residual at iteration 380
0.0000009257 = residual at iteration 390
0.0013733614 = residual at iteration 400
0.0000015722 = residual at iteration 410
```

```
 0.0000001391 = residual at iteration 420
 0.0001462475 = residual at iteration 430
 0.0000002786 = residual at iteration 440
 0.0219888128 = residual at iteration 450
 0.0000038609 = residual at iteration 460
 0.0360298306 = residual at iteration 470
 0.0017441950 = residual at iteration 480
 0.0011358712 = residual at iteration 490
 0.0000054351 = residual at iteration 500
 0.0000003418 = residual at iteration 510
 0.0019637651 = residual at iteration 520
 0.0000085876 = residual at iteration 530
 0.0000002480 = residual at iteration 540
 0.0137247192 = residual at iteration 550
 0.0000003620 = residual at iteration 560
 0.0257015284 = residual at iteration 570
 0.0000244465 = residual at iteration 580
 0.0266697444 = residual at iteration 590
 0.0002037403 = residual at iteration 600
 0.0000006067 = residual at iteration 610
 0.0519573390 = residual at iteration 620
 0.0000061911 = residual at iteration 630
 0.0000001330 = residual at iteration 640
 0.0010920146 = residual at iteration 650
 0.0000006526 = residual at iteration 660
 0.0281537510 = residual at iteration 670
 0.0000995034 = residual at iteration 680
 0.0000004565 = residual at iteration 690
 0.0236719064 = residual at iteration 700
 0.0001467171 = residual at iteration 710
 0.0000002624 = residual at iteration 720
 0.0058674277 = residual at iteration 730
 0.0000000900 = residual at iteration 736
 0.1901101768 = eigen value


Length of gradient:     2.199
Length of segments:  0.14  0.16  0.19  0.22  0.23  0.23  0.23  0.22  0.21  0.19
Length of segments:  0.17
Length of gradient:     2.206
```

```
Length of gradient:     2.093
Length of segments:  0.17  0.18  0.19  0.20  0.21  0.20  0.20  0.19  0.19  0.18
Length of segments:  0.18
Length of gradient:     2.058


                    ---------- Axis 3 ----------

 0.0310038384 = residual at iteration   0
 0.0173553042 = residual at iteration   1
 0.0016156781 = residual at iteration   2
 0.0009997393 = residual at iteration   3
 0.0001474884 = residual at iteration   4
 0.0000939782 = residual at iteration   5
 0.0000143278 = residual at iteration   6
 0.0000102287 = residual at iteration   7
 0.0000016801 = residual at iteration   8
 0.0000012742 = residual at iteration   9
 0.0000001931 = residual at iteration  10
 0.0000003428 = residual at iteration  11
 0.0000001111 = residual at iteration  12
 0.0232288614 = residual at iteration  13
 0.0013387522 = residual at iteration  14
 0.0035687031 = residual at iteration  15
 0.0001409633 = residual at iteration  16
 0.0000757733 = residual at iteration  17
 0.0000311961 = residual at iteration  18
 0.0000190051 = residual at iteration  19
 0.0000080280 = residual at iteration  20
 0.0000049353 = residual at iteration  21
 0.0000020968 = residual at iteration  22
 0.0000013025 = residual at iteration  23
 0.0000005570 = residual at iteration  24
 0.0000003746 = residual at iteration  25
 0.0000001893 = residual at iteration  26
 0.0217562038 = residual at iteration  27
 0.0019477027 = residual at iteration  28
 0.0052403896 = residual at iteration  29
 0.0001959897 = residual at iteration  30
 0.0001458934 = residual at iteration  31
```

```
 0.0000183180 = residual at iteration  32
 0.0000142958 = residual at iteration  33
 0.0000020140 = residual at iteration  34
 0.0000016813 = residual at iteration  35
 0.0000001949 = residual at iteration  36
 0.0000175658 = residual at iteration  37
 0.0000038365 = residual at iteration  38
 0.0000001150 = residual at iteration  39
 0.0000001578 = residual at iteration  40
 0.0000000791 = residual at iteration  41
 0.1021367759 = eigen value


Length of gradient:     1.615
Length of segments:  0.11  0.11  0.13  0.17  0.19  0.20  0.20  0.19  0.17  0.15
Length of gradient:     1.680


Length of gradient:     1.623
Length of segments:  0.14  0.15  0.17  0.18  0.18  0.18  0.17  0.16  0.15  0.14
Length of gradient:     1.603
```

Fall 2006 (All Available Habitats)

SPECIES SCORES

```
    N    NAME     AX1  AX2  AX3      |      RANKED 1      |      RANKED 2
                                     |     EIG=0.461      |     EIG=0.190      |
    1 t8          179   83  226      |    40 t1268    403 |    53 t2328    432 |
    2 t128        110  173  373      |    93 t5063    403 |   200 t8608    420 |
    3 t130         60  185  215      |    48 t2010    403 |     4 t134     403 |
    4 t134        -26  403 -188      |   159 t8410    391 |    43 t1498    370 |
    5 t138         77  183  102      |   134 t7560    384 |   198 t8528    360 |
    6 t151        -65  277  251      |    95 t5130    377 |   100 t5508    360 |
    7 t153        -76 -175   94      |    90 t5030    373 |   160 t8411    343 |
    8 t155        -46   75  166      |   195 t8490    372 |   199 t8560    343 |
    9 t161        200  -31  -11      |   151 t8356    370 |   107 t6030    326 |
   10 t162        135  182  -29      |   204 t8730    370 |   125 t6743    320 |
```

11	t171	-11	-130	9	49	t2020	366	157	t8404	316
12	t189	-13	29	304	138	t8060	365	18	t380	312
13	t198	151	240	10	41	t1390	365	111	t6180	304
14	t258	30	118	138	36	t1180	353	89	t4370	296
15	t278	-52	261	651	147	t8300	349	112	t6210	286
16	t288	202	-2	119	29	t1040	348	79	t4200	285
17	t308	43	117	148	65	t2690	335	175	t8451	285
18	t380	-36	312	-142	34	t1123	335	186	t8467	285
19	t511	163	1	7	75	t4050	335	188	t8469	285
20	t550	-142	256	343	38	t1260	335	68	t2800	281
21	t651	60	250	-115	98	t5400	335	117	t6560	281
22	t750	-4	102	107	229	t9538	330	6	t151	277
23	t757	242	169	256	45	t1550	328	69	t2840	274
24	t762	225	-18	64	31	t1050	316	215	t8999	272
25	t773	175	242	155	39	t1263	315	59	t2460	272
26	t781	39	243	8	181	t8461	311	187	t8468	268
27	t1028	7	245	-136	94	t5070	303	220	t9290	267
28	t1030	243	-12	120	172	t8443	301	162	t8415	262
29	t1040	348	84	83	150	t8354	300	15	t278	261
30	t1046	214	-28	-7	101	t5660	300	64	t2681	257
31	t1050	316	31	129	106	t6020	299	20	t550	256
32	t1070	54	-9	72	211	t8990	294	110	t6130	256
33	t1115	289	139	26	185	t8466	293	21	t651	250
34	t1123	335	72	103	73	t3510	291	230	t9908	250
35	t1138	233	-2	192	91	t5058	291	131	t6904	248
36	t1180	353	49	101	96	t5160	291	136	t7768	248
37	t1240	252	162	-32	218	t9220	291	103	t5940	248
38	t1260	335	72	103	33	t1115	289	208	t8984	248
39	t1263	315	138	161	154	t8385	288	123	t6740	248
40	t1268	403	106	90	196	t8491	288	62	t2650	248
41	t1390	365	85	107	178	t8457	283	27	t1028	245
42	t1444	121	151	216	163	t8416	282	26	t781	243
43	t1498	88	370	-121	182	t8462	280	25	t773	242
44	t1500	252	162	412	227	t9430	270	13	t198	240
45	t1550	328	164	44	60	t2491	270	217	t9118	240
46	t1650	174	203	396	176	t8453	265	124	t6741	238
47	t1653	66	-68	1	135	t7610	264	132	t7510	237
48	t2010	403	106	90	50	t2120	263	205	t8750	236
49	t2020	366	66	124	228	t9450	262	144	t8209	231
50	t2120	263	160	8	74	t4030	258	149	t8352	231
51	t2160	220	130	211	63	t2660	258	116	t6480	231

52	t2190	-70	143	249	125	t6743	257	226	t9428	229	
53	t2328	109	432	-168	139	t8070	255	206	t8798	228	
54	t2351	62	201	311	37	t1240	252	222	t9340	228	
55	t2353	245	201	-160	44	t1500	252	191	t8472	226	
56	t2361	47	167	-21	97	t5360	251	225	t9390	225	
57	t2408	56	-74	388	130	t6890	249	183	t8464	223	
58	t2430	-24	187	352	129	t6851	248	174	t8450	221	
59	t2460	128	272	86	148	t8340	248	178	t8457	221	
60	t2491	270	179	335	155	t8386	247	101	t5660	220	
61	t2628	-39	-56	179	191	t8472	247	106	t6020	220	
62	t2650	189	248	660	55	t2353	245	120	t6680	219	
63	t2660	258	84	186	180	t8460	243	196	t8491	217	
64	t2681	-42	257	402	28	t1030	243	182	t8462	214	
65	t2690	335	72	103	23	t757	242	94	t5070	213	
66	t2730	-55	-9	204	127	t6801	241	227	t9430	213	
67	t2750	105	183	212	194	t8488	240	71	t2920	212	
68	t2800	-212	281	-29	197	t8493	239	83	t4204	208	
69	t2840	32	274	-61	35	t1138	233	46	t1650	203	
70	t2901	-82	162	223	156	t8402	225	231	t9950	203	
71	t2920	86	212	190	24	t762	225	55	t2353	201	
72	t2925	-58	-52	194	79	t4200	224	54	t2351	201	
73	t3510	291	7	165	175	t8451	224	224	t9380	201	
74	t4030	258	142	118	188	t8469	224	173	t8446	200	
75	t4050	335	72	103	103	t5940	223	202	t8630	199	
76	t4110	164	-21	97	104	t5960	223	161	t8413	196	
77	t4140	209	-49	80	51	t2160	220	166	t8436	196	
78	t4170	-68	64	295	124	t6741	219	129	t6851	194	
79	t4200	224	285	-172	167	t8437	214	142	t8140	194	
80	t4201	-21	61	184	30	t1046	214	141	t8130	192	
81	t4202	-45	-52	235	128	t6810	212	221	t9310	187	
82	t4203	-51	157	-62	77	t4140	209	193	t8482	187	
83	t4204	-59	208	386	209	t8987	209	102	t5868	187	
84	t4210	-174	125	195	137	t8010	207	58	t2430	187	
85	t4230	10	122	235	193	t8482	203	3	t130	185	
86	t4248	59	18	-84	16	t288	202	67	t2750	183	
87	t4266	87	-60	-28	153	t8382	202	5	t138	183	
88	t4290	139	178	22	121	t6721	202	165	t8435	182	
89	t4370	11	296	-112	122	t6726	202	10	t162	182	
90	t5030	373	89	99	9	t161	200	148	t8340	181	
91	t5058	291	7	165	184	t8465	193	211	t8990	179	
92	t5061	63	54	166	105	t6010	192	60	t2491	179	

93	t5063	403	106	90	|	131	t6904	189	|	88	t4290	178 |
94	t5070	303	213	-7	|	136	t7768	189	|	150	t8354	176 |
95	t5130	377	91	98	|	208	t8984	189	|	2	t128	173 |
96	t5160	291	7	165	|	231	t9950	189	|	23	t757	169 |
97	t5360	251	-10	128	|	123	t6740	189	|	56	t2361	167 |
98	t5400	335	72	103	|	62	t2650	189	|	45	t1550	164 |
99	t5440	32	-10	226	|	201	t8610	186	|	127	t6801	163 |
100	t5508	-122	360	-254	|	1	t8	179	|	70	t2901	162 |
101	t5660	300	220	-9	|	25	t773	175	|	37	t1240	162 |
102	t5868	-24	187	352	|	46	t1650	174	|	44	t1500	162 |
103	t5940	223	248	-41	|	214	t8994	174	|	109	t6118	162 |
104	t5960	223	125	212	|	115	t6400	166	|	179	t8459	161 |
105	t6010	192	55	95	|	171	t8441	166	|	50	t2120	160 |
106	t6020	299	220	-14	|	76	t4110	164	|	82	t4203	157 |
107	t6030	-166	326	10	|	19	t511	163	|	172	t8443	153 |
108	t6090	-7	-120	11	|	202	t8630	155	|	42	t1444	151 |
109	t6118	-45	162	-155	|	13	t198	151	|	223	t9370	145 |
110	t6130	-142	256	343	|	114	t6312	149	|	52	t2190	143 |
111	t6180	141	304	-87	|	177	t8454	147	|	74	t4030	142 |
112	t6210	63	286	5	|	224	t9380	143	|	216	t9025	142 |
113	t6310	7	-92	206	|	141	t8130	142	|	33	t1115	139 |
114	t6312	149	-36	-23	|	111	t6180	141	|	39	t1263	138 |
115	t6400	166	-11	83	|	88	t4290	139	|	152	t8358	137 |
116	t6480	122	231	132	|	165	t8435	135	|	177	t8454	137 |
117	t6560	-212	281	-29	|	10	t162	135	|	185	t8466	137 |
118	t6580	35	-11	166	|	212	t8991	132	|	214	t8994	132 |
119	t6650	99	-54	-81	|	59	t2460	128	|	51	t2160	130 |
120	t6680	-24	219	166	|	149	t8352	122	|	201	t8610	129 |
121	t6721	202	-2	119	|	116	t6480	122	|	84	t4210	125 |
122	t6726	202	-2	119	|	42	t1444	121	|	104	t5960	125 |
123	t6740	189	248	660	|	183	t8464	120	|	171	t8441	124 |
124	t6741	219	238	184	|	174	t8450	117	|	85	t4230	122 |
125	t6743	257	320	-64	|	2	t128	110	|	156	t8402	119 |
126	t6768	47	-10	28	|	53	t2328	109	|	14	t258	118 |
127	t6801	241	163	318	|	67	t2750	105	|	128	t6810	117 |
128	t6810	212	117	12	|	216	t9025	103	|	17	t308	117 |
129	t6851	248	194	442	|	119	t6650	99	|	146	t8239	114 |
130	t6890	249	3	150	|	205	t8750	92	|	168	t8438	113 |
131	t6904	189	248	660	|	43	t1498	88	|	210	t8989	111 |
132	t7510	66	237	-24	|	87	t4266	87	|	213	t8993	109 |
133	t7544	-61	-49	177	|	71	t2920	86	|	93	t5063	106 |

134	t7560	384	88	99	|	5	t138	77	|	40	t1268	106	|
135	t7610	264	42	55	|	132	t7510	66	|	48	t2010	106	|
136	t7768	189	248	660	|	47	t1653	66	|	22	t750	102	|
137	t8010	207	79	-56	|	92	t5061	63	|	159	t8410	100	|
138	t8060	365	72	117	|	112	t6210	63	|	195	t8490	99	|
139	t8070	255	-28	-38	|	54	t2351	62	|	95	t5130	91	|
140	t8120	-27	85	-46	|	21	t651	60	|	163	t8416	91	|
141	t8130	142	192	285	|	3	t130	60	|	90	t5030	89	|
142	t8140	11	194	218	|	86	t4248	59	|	134	t7560	88	|
143	t8170	-44	-1	154	|	57	t2408	56	|	151	t8356	87	|
144	t8209	-127	231	227	|	32	t1070	54	|	140	t8120	85	|
145	t8219	-29	-99	23	|	56	t2361	47	|	41	t1390	85	|
146	t8239	17	114	132	|	190	t8471	47	|	29	t1040	84	|
147	t8300	349	54	100	|	126	t6768	47	|	63	t2660	84	|
148	t8340	248	181	150	|	17	t308	43	|	1	t8	83	|
149	t8352	122	231	132	|	186	t8467	40	|	203	t8640	81	|
150	t8354	300	176	-52	|	26	t781	39	|	204	t8730	81	|
151	t8356	370	87	89	|	168	t8438	35	|	192	t8474	81	|
152	t8358	4	137	22	|	118	t6580	35	|	137	t8010	79	|
153	t8382	202	-2	119	|	69	t2840	32	|	8	t155	75	|
154	t8385	288	50	2	|	99	t5440	32	|	65	t2690	72	|
155	t8386	247	25	71	|	14	t258	30	|	138	t8060	72	|
156	t8402	225	119	242	|	222	t9340	30	|	38	t1260	72	|
157	t8404	-31	316	-56	|	169	t8439	30	|	34	t1123	72	|
158	t8406	7	-92	206	|	230	t9908	27	|	98	t5400	72	|
159	t8410	391	100	92	|	146	t8239	17	|	75	t4050	72	|
160	t8411	-194	343	237	|	142	t8140	11	|	167	t8437	67	|
161	t8413	-55	196	-29	|	89	t4370	11	|	49	t2020	66	|
162	t8415	-133	262	-144	|	85	t4230	10	|	194	t8488	65	|
163	t8416	282	91	-18	|	113	t6310	7	|	78	t4170	64	|
164	t8430	-75	59	293	|	158	t8406	7	|	80	t4201	61	|
165	t8435	135	182	161	|	27	t1028	7	|	164	t8430	59	|
166	t8436	-36	196	272	|	189	t8470	6	|	105	t6010	55	|
167	t8437	214	67	92	|	152	t8358	4	|	147	t8300	54	|
168	t8438	35	113	172	|	219	t9288	2	|	92	t5061	54	|
169	t8439	30	-84	-97	|	22	t750	-4	|	154	t8385	50	|
170	t8440	-42	-3	4	|	108	t6090	-7	|	36	t1180	49	|
171	t8441	166	124	283	|	11	t171	-11	|	176	t8453	49	|
172	t8443	301	153	-4	|	179	t8459	-13	|	197	t8493	43	|
173	t8446	-74	200	207	|	12	t189	-13	|	135	t7610	42	|
174	t8450	117	221	-47	|	217	t9118	-14	|	229	t9538	40	|

175	t8451	224	285	-172		223	t9370	-19	31	t1050	31
176	t8453	265	49	135		80	t4201	-21	12	t189	29
177	t8454	147	137	128		102	t5868	-24	181	t8461	27
178	t8457	283	221	6		221	t9310	-24	155	t8386	25
179	t8459	-13	161	-7		58	t2430	-24	209	t8987	23
180	t8460	243	-12	120		120	t6680	-24	86	t4248	18
181	t8461	311	27	130		4	t134	-26	73	t3510	7
182	t8462	280	214	-39		140	t8120	-27	91	t5058	7
183	t8464	120	223	11		145	t8219	-29	96	t5160	7
184	t8465	193	-40	117		157	t8404	-31	218	t9220	7
185	t8466	293	137	19		18	t380	-36	207	t8978	5
186	t8467	40	285	-19		166	t8436	-36	190	t8471	4
187	t8468	-141	268	159		207	t8978	-37	130	t6890	3
188	t8469	224	285	-172		61	t2628	-39	19	t511	1
189	t8470	6	-6	46		64	t2681	-42	143	t8170	-1
190	t8471	47	4	253		170	t8440	-42	35	t1138	-2
191	t8472	247	226	-31		143	t8170	-44	153	t8382	-2
192	t8474	-45	81	310		192	t8474	-45	16	t288	-2
193	t8482	203	187	-22		81	t4202	-45	121	t6721	-2
194	t8488	240	65	118		109	t6118	-45	122	t6726	-2
195	t8490	372	99	85		203	t8640	-45	170	t8440	-3
196	t8491	288	217	-75		8	t155	-46	189	t8470	-6
197	t8493	239	43	155		82	t4203	-51	228	t9450	-6
198	t8528	-122	360	-254		15	t278	-52	66	t2730	-9
199	t8560	-194	343	237		66	t2730	-55	32	t1070	-9
200	t8608	-80	420	-253		161	t8413	-55	99	t5440	-10
201	t8610	186	129	158		72	t2925	-58	97	t5360	-10
202	t8630	155	199	182		83	t4204	-59	126	t6768	-10
203	t8640	-45	81	310		225	t9390	-59	115	t6400	-11
204	t8730	370	81	109		133	t7544	-61	118	t6580	-11
205	t8750	92	236	81		6	t151	-65	28	t1030	-12
206	t8798	-88	228	201		226	t9428	-65	180	t8460	-12
207	t8978	-37	5	236		210	t8989	-66	24	t762	-18
208	t8984	189	248	660		78	t4170	-68	219	t9288	-20
209	t8987	209	23	41		52	t2190	-70	76	t4110	-21
210	t8989	-66	111	253		173	t8446	-74	139	t8070	-28
211	t8990	294	179	0		164	t8430	-75	30	t1046	-28
212	t8991	132	-44	-36		7	t153	-76	9	t161	-31
213	t8993	-143	109	-34		200	t8608	-80	114	t6312	-36
214	t8994	174	132	-18		70	t2901	-82	184	t8465	-40
215	t8999	-113	272	165		206	t8798	-88	212	t8991	-44

216	t9025	103	142	-12	215	t8999	-113	77	t4140	-49
217	t9118	-14	240	-61	100	t5508	-122	133	t7544	-49
218	t9220	291	7	165	198	t8528	-122	81	t4202	-52
219	t9288	2	-20	148	144	t8209	-127	72	t2925	-52
220	t9290	-159	267	254	162	t8415	-133	119	t6650	-54
221	t9310	-24	187	352	187	t8468	-141	61	t2628	-56
222	t9340	30	228	25	110	t6130	-142	87	t4266	-60
223	t9370	-19	145	226	20	t550	-142	47	t1653	-68
224	t9380	143	201	175	213	t8993	-143	57	t2408	-74
225	t9390	-59	225	-16	220	t9290	-159	169	t8439	-84
226	t9428	-65	229	232	107	t6030	-166	158	t8406	-92
227	t9430	270	213	-61	84	t4210	-174	113	t6310	-92
228	t9450	262	-6	139	160	t8411	-194	145	t8219	-99
229	t9538	330	40	105	199	t8560	-194	108	t6090	-120
230	t9908	27	250	152	117	t6560	-212	11	t171	-130
231	t9950	189	203	533	68	t2800	-212	7	t153	-175

Fall 2006 (All Available Habitats)

SAMPLE SCORES - WHICH ARE WEIGHTED MEAN SPECIES SCORES

N	NAME	AX1	AX2	AX3	RANKED 1 EIG=0.461			RANKED 2 EIG=0.190		
1	HC1_00	153	148	158	12	HC1_95	281	15	LD4_03	205
2	CC1_01	202	87	112	13	HC2_95	240	9	NF10_RP	192
3	CC1_03	171	90	119	31	LD1_95	218	30	NF10_GP	181
4	NF1_RP	140	63	80	32	LD2_95	215	32	LD2_95	154
5	NF6_RP	90	131	90	2	CC1_01	202	33	LD2_98	154
6	NF7_RP	75	128	144	3	CC1_03	171	14	LD1_00	154
7	NF8_RP	32	147	146	14	LD1_00	162	31	LD1_95	153
8	NF9_RP	55	152	160	1	HC1_00	153	8	NF9_RP	152
9	NF10_RP	14	192	148	4	NF1_RP	140	17	LD3_03	149
10	HC1_06	90	118	107	33	LD2_98	100	1	HC1_00	148
11	CC1_06	84	115	95	5	NF6_RP	90	7	NF8_RP	147
12	HC1_95	281	93	90	10	HC1_06	90	29	NF9_GP	136
13	HC2_95	240	98	89	20	NF1_GP	85	16	LD2_03	135
14	LD1_00	162	154	51	11	CC1_06	84	5	NF6_RP	131
15	LD4_03	42	205	0	22	NF3_GP	77	26	NF6_GP	130

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    16 LD2_03      58  135   25      |    26 NF6_GP     77 |     6 NF7_RP    128 |
    17 LD3_03      35  149   16      |     6 NF7_RP     75 |    10 HC1_06    118 |
    18 LD1_06      51  112   44      |    21 NF2_GP     71 |    28 NF8_GP    117 |
    19 LD2_06      21   84   64      |    16 LD2_03     58 |    11 CC1_06    115 |
    20 NF1_GP      85   53   44      |    34 LD3_98     58 |    18 LD1_06    112 |
    21 NF2_GP      71   52   92      |    27 NF7_GP     58 |    27 NF7_GP    110 |
    22 NF3_GP      77   45   74      |     8 NF9_RP     55 |    34 LD3_98    101 |
    23 NF4a_GP     27    0   71      |    18 LD1_06     51 |    13 HC2_95     98 |
    24 NF5_GP      40   38   62      |    29 NF9_GP     50 |    12 HC1_95     93 |
    25 NF4b_GP     23    0   72      |    15 LD4_03     42 |     3 CC1_03     90 |
    26 NF6_GP      77  130   97      |    24 NF5_GP     40 |     2 CC1_01     87 |
    27 NF7_GP      58  110  121      |    17 LD3_03     35 |    19 LD2_06     84 |
    28 NF8_GP      20  117  120      |     7 NF8_RP     32 |     4 NF1_RP     63 |
    29 NF9_GP      50  136  151      |    23 NF4a_GP    27 |    20 NF1_GP     53 |
    30 NF10_GP      0  181  143      |    25 NF4b_GP    23 |    21 NF2_GP     52 |
    31 LD1_95     218  153   43      |    19 LD2_06     21 |    22 NF3_GP     45 |
    32 LD2_95     215  154   44      |    28 NF8_GP     20 |    24 NF5_GP     38 |
    33 LD2_98     100  154   82      |     9 NF10_RP    14 |    23 NF4a_GP     0 |
    34 LD3_98      58  101  105      |    30 NF10_GP     0 |    25 NF4b_GP     0 |

*************************** Calculations finished ***************************
```

```
****************** Detrended Correspondence Analysis (DCA) ******************
PC-ORD, Version 4.14
19 Feb 2008, 15:13

Spring 2007(Riffle Pool and Glide/Pool)
Number of non-zero data items:     1993

No downweighting
Axes are rescaled
Number of segments: 30
Threshold:  0.00



Total variance ("inertia") in the species data:   2.4477


                    ---------- Axis 1 ----------

 0.1219951063 = residual at iteration   0
 0.0160559695 = residual at iteration   1
 0.0017819856 = residual at iteration   2
 0.0001219823 = residual at iteration   3
 0.0000146682 = residual at iteration   4
 0.0000010631 = residual at iteration   5
 0.0000004220 = residual at iteration   6
 0.0000007050 = residual at iteration   7
 0.0000002500 = residual at iteration   8
 0.1008074507 = residual at iteration   9
 0.0043596849 = residual at iteration  10
 0.0002987277 = residual at iteration  11
 0.0000130956 = residual at iteration  12
 0.0000014595 = residual at iteration  13
 0.0000003040 = residual at iteration  14
 0.0781665221 = residual at iteration  15
 0.0144913690 = residual at iteration  16
 0.0010961315 = residual at iteration  17
 0.0000688515 = residual at iteration  18
 0.0000065032 = residual at iteration  19
```

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0.0000005094 = residual at iteration  20
0.0492467657 = residual at iteration  21
0.0477069803 = residual at iteration  22
0.0036376151 = residual at iteration  23
0.0003588983 = residual at iteration  24
0.0000255750 = residual at iteration  25
0.0000025600 = residual at iteration  26
0.0000002888 = residual at iteration  27
0.0839764550 = residual at iteration  28
0.0222761612 = residual at iteration  29
0.0022742911 = residual at iteration  30
0.0002202008 = residual at iteration  31
0.0000224503 = residual at iteration  32
0.0000022376 = residual at iteration  33
0.0000003631 = residual at iteration  34
0.0788499266 = residual at iteration  35
0.0241943542 = residual at iteration  36
0.0025473412 = residual at iteration  37
0.0002382193 = residual at iteration  38
0.0000272519 = residual at iteration  39
0.0000027669 = residual at iteration  40
0.0000003896 = residual at iteration  41
0.0473325849 = residual at iteration  42
0.0428249426 = residual at iteration  43
0.0046310760 = residual at iteration  44
0.0003429274 = residual at iteration  45
0.0000296919 = residual at iteration  46
0.0000022023 = residual at iteration  47
0.0000002802 = residual at iteration  48
0.0000003211 = residual at iteration  49
0.0077365898 = residual at iteration  50
0.0000005632 = residual at iteration  60
0.0691039413 = residual at iteration  70
0.0000013576 = residual at iteration  80
0.0053932844 = residual at iteration  90
0.0000082306 = residual at iteration 100
0.0000008106 = residual at iteration 110
0.0127133681 = residual at iteration 120
0.0000600054 = residual at iteration 130
0.0000001892 = residual at iteration 140
0.0001935742 = residual at iteration 150
```

```
0.0000019339 = residual at iteration 160
0.0842100978 = residual at iteration 170
0.0004378055 = residual at iteration 180
0.0000043306 = residual at iteration 190
0.0259298086 = residual at iteration 200
0.0000437568 = residual at iteration 210
0.0472389348 = residual at iteration 220
0.0003994661 = residual at iteration 230
0.0000005349 = residual at iteration 240
0.0006247499 = residual at iteration 250
0.0000009807 = residual at iteration 260
0.0000002924 = residual at iteration 270
0.0019411740 = residual at iteration 280
0.0000006267 = residual at iteration 290
0.0032571552 = residual at iteration 300
0.0000789507 = residual at iteration 310
0.0593428090 = residual at iteration 320
0.1016400382 = residual at iteration 330
0.0000185546 = residual at iteration 340
0.0000008118 = residual at iteration 350
0.0300562512 = residual at iteration 360
0.0002257302 = residual at iteration 370
0.0000002972 = residual at iteration 380
0.0521644317 = residual at iteration 390
0.0040026950 = residual at iteration 400
0.0000022673 = residual at iteration 410
0.0380193405 = residual at iteration 420
0.0001653230 = residual at iteration 430
0.0000001992 = residual at iteration 440
0.0000006602 = residual at iteration 450
0.0045634112 = residual at iteration 460
0.0000063875 = residual at iteration 470
0.0394510962 = residual at iteration 480
0.0000346114 = residual at iteration 490
0.0554664433 = residual at iteration 500
0.0000981684 = residual at iteration 510
0.0607648343 = residual at iteration 520
0.0004634017 = residual at iteration 530
0.0000007808 = residual at iteration 540
0.0173554476 = residual at iteration 550
0.0000012005 = residual at iteration 560
```

```
 0.0001417256 = residual at iteration 570
 0.0000001864 = residual at iteration 580
 0.0099261235 = residual at iteration 590
 0.0000054557 = residual at iteration 600
 0.0040105167 = residual at iteration 610
 0.0000015639 = residual at iteration 620
 0.0854327902 = residual at iteration 630
 0.0000275393 = residual at iteration 640
 0.0000002313 = residual at iteration 650
 0.0014560650 = residual at iteration 660
 0.0000023975 = residual at iteration 670
 0.0833516121 = residual at iteration 680
 0.0000641111 = residual at iteration 690
 0.0000002966 = residual at iteration 700
 0.0155149726 = residual at iteration 710
 0.0000215217 = residual at iteration 720
 0.0520180315 = residual at iteration 730
 0.0002819820 = residual at iteration 740
 0.0000002902 = residual at iteration 750
 0.0000000859 = residual at iteration 751
 0.3051255643 = eigen value


Length of gradient:     1.902
Length of segments:  0.28  0.27  0.25  0.22  0.19  0.16  0.14  0.13  0.13  0.12
Length of gradient:     2.114


Length of gradient:     2.232
Length of segments:  0.20  0.20  0.20  0.20  0.20  0.19  0.19  0.18  0.17  0.17
Length of segments:  0.17  0.17
Length of gradient:     2.229


                    ---------- Axis 2 ----------

 0.0776567906 = residual at iteration   0
 0.0133906985 = residual at iteration   1
 0.0008342409 = residual at iteration   2
 0.0000414710 = residual at iteration   3
 0.0000036918 = residual at iteration   4
```

```
 0.0000002850 = residual at iteration   5
 0.0003614715 = residual at iteration   6
 0.0000342130 = residual at iteration   7
 0.0000018571 = residual at iteration   8
 0.0000001870 = residual at iteration   9
 0.0000000395 = residual at iteration  10
 0.2277974188 = eigen value


Length of gradient:     2.232
Length of segments:  0.21  0.22  0.23  0.23  0.23  0.22  0.20  0.17  0.15  0.13
Length of segments:  0.12  0.12
Length of gradient:     2.410


Length of gradient:     2.419
Length of segments:  0.17  0.18  0.20  0.21  0.21  0.21  0.20  0.20  0.19  0.18
Length of segments:  0.17  0.16  0.16
Length of gradient:     2.397


                    ---------- Axis 3 ----------

 0.0393378474 = residual at iteration   0
 0.0038072814 = residual at iteration   1
 0.0008924358 = residual at iteration   2
 0.0001981135 = residual at iteration   3
 0.0000519489 = residual at iteration   4
 0.0000122038 = residual at iteration   5
 0.0000032179 = residual at iteration   6
 0.0000007637 = residual at iteration   7
 0.0000002123 = residual at iteration   8
 0.0000000753 = residual at iteration   9
 0.1125715673 = eigen value


Length of gradient:     1.573
Length of segments:  0.15  0.15  0.17  0.17  0.17  0.17  0.17  0.16  0.14  0.13
Length of gradient:     1.581
```

Length of gradient: 1.563
Length of segments: 0.14 0.15 0.16 0.16 0.16 0.16 0.16 0.16 0.15 0.15
Length of gradient: 1.556

Spring 2007(Riffle Pool and Glide/Pool)

SPECIES SCORES

N	NAME	AX1	AX2	AX3	RANKED 1 EIG=0.305			RANKED 2 EIG=0.228		
1	t8	27	372	54	37	t1050	404	4	t130	431
2	t108	343	185	-247	75	t3440	404	1	t8	372
3	t128	163	-91	230	182	t8419	404	209	t8471	367
4	t130	-27	431	255	127	t6894	404	232	t8987	362
5	t134	291	39	-59	33	t1012	398	68	t2901	335
6	t138	45	76	-16	17	t278	377	49	t1498	331
7	t151	-122	91	21	82	t4030	377	190	t8440	329
8	t153	-23	285	297	45	t1390	377	95	t5510	311
9	t155	-42	257	185	193	t8444	377	69	t2925	304
10	t161	201	-12	210	54	t2010	377	242	t9290	296
11	t162	183	24	75	141	t8057	372	16	t258	290
12	t164	-142	43	213	243	t9310	372	163	t8358	289
13	t171	176	275	231	94	t5380	367	132	t7544	286
14	t189	70	42	173	80	t3681	362	8	t153	285
15	t198	99	48	10	36	t1040	360	205	t8465	281
16	t258	85	290	48	78	t3641	360	194	t8446	275
17	t278	377	68	268	76	t3508	358	13	t171	275
18	t308	80	184	-12	142	t8060	356	200	t8459	272
19	t380	34	168	47	73	t3200	351	251	t9450	270
20	t410	124	60	173	2	t108	343	143	t8080	266
21	t511	223	171	155	42	t1180	343	57	t2190	266
22	t520	-273	103	-113	23	t540	343	137	t8008	258
23	t540	343	185	-247	131	t7540	340	9	t155	257
24	t550	180	109	-5	195	t8450	335	206	t8466	254
25	t580	290	80	45	133	t7560	334	116	t6400	254
26	t651	87	218	185	162	t8356	334	30	t781	250
27	t750	325	74	247	146	t8110	333	106	t5960	249
28	t757	249	49	-18	199	t8457	332	233	t8989	249

29	t773	123	79	87	|	229	t8982	328 |	172	t8402	244 |
30	t781	59	250	116	|	214	t8490	326 |	189	t8438	244 |
31	t1010	-115	-222	55	|	202	t8461	325 |	84	t4203	239 |
32	t1011	-14	-245	154	|	27	t750	325 |	66	t2730	236 |
33	t1012	398	59	172	|	93	t5360	323 |	79	t3680	236 |
34	t1020	233	-73	-18	|	108	t6020	319 |	83	t4202	236 |
35	t1030	305	138	-75	|	166	t8385	312 |	166	t8385	225 |
36	t1040	360	37	163	|	250	t9430	309 |	115	t6312	224 |
37	t1050	404	57	147	|	224	t8734	308 |	85	t4230	221 |
38	t1070	-240	81	119	|	35	t1030	305 |	215	t8493	221 |
39	t1094	17	53	557	|	203	t8462	305 |	26	t651	218 |
40	t1115	186	-122	298	|	211	t8482	303 |	161	t8354	216 |
41	t1138	48	-16	-207	|	91	t5130	297 |	202	t8461	215 |
42	t1180	343	185	-247	|	44	t1263	294 |	124	t6810	215 |
43	t1240	287	-7	179	|	171	t8401	292 |	246	t9370	212 |
44	t1263	294	29	52	|	89	t5030	292 |	86	t4248	209 |
45	t1390	377	68	268	|	62	t2491	292 |	136	t7790	207 |
46	t1440	221	-144	111	|	5	t134	291 |	97	t5628	203 |
47	t1444	202	135	21	|	25	t580	290 |	247	t9380	201 |
48	t1445	-81	-229	93	|	43	t1240	287 |	239	t9118	199 |
49	t1498	-72	331	296	|	176	t8410	283 |	187	t8436	197 |
50	t1530	234	-53	346	|	107	t6010	281 |	248	t9390	197 |
51	t1550	255	-72	69	|	81	t3690	274 |	130	t7510	195 |
52	t1600	209	-105	-26	|	92	t5240	263 |	154	t8239	192 |
53	t1653	151	177	166	|	135	t7768	260 |	179	t8413	191 |
54	t2010	377	68	268	|	231	t8986	260 |	111	t6090	191 |
55	t2120	237	175	140	|	98	t5630	257 |	153	t8219	189 |
56	t2160	117	106	-78	|	213	t8488	256 |	2	t108	185 |
57	t2190	35	266	156	|	254	t9950	256 |	42	t1180	185 |
58	t2351	253	-35	130	|	51	t1550	255 |	23	t540	185 |
59	t2361	212	103	126	|	159	t8340	253 |	135	t7768	184 |
60	t2430	175	125	121	|	192	t8443	253 |	18	t308	184 |
61	t2460	83	22	158	|	58	t2351	253 |	138	t8010	181 |
62	t2491	292	35	137	|	174	t8405	251 |	196	t8453	177 |
63	t2628	176	-149	160	|	88	t4290	250 |	53	t1653	177 |
64	t2660	222	31	77	|	28	t757	249 |	55	t2120	175 |
65	t2681	144	63	-74	|	230	t8984	249 |	21	t511	171 |
66	t2730	0	236	632	|	235	t8993	249 |	128	t6904	170 |
67	t2840	-18	59	66	|	220	t8630	246 |	195	t8450	169 |
68	t2901	153	335	110	|	77	t3590	244 |	152	t8208	168 |
69	t2925	-103	304	200	|	210	t8472	244 |	19	t380	168 |

70	t3020	159	10	221	|	134	t7610	243	|	249	t9428	157	|
71	t3071	3	-32	250	|	206	t8466	241	|	156	t8299	155	|
72	t3140	209	-105	-26	|	152	t8208	240	|	253	t9908	154	|
73	t3200	351	28	144	|	251	t9450	240	|	147	t8120	153	|
74	t3300	209	-105	-26	|	164	t8382	239	|	226	t8978	152	|
75	t3440	404	57	147	|	55	t2120	237	|	93	t5360	148	|
76	t3508	358	7	239	|	50	t1530	234	|	35	t1030	138	|
77	t3590	244	3	-28	|	34	t1020	233	|	47	t1444	135	|
78	t3641	360	10	150	|	99	t5660	233	|	159	t8340	131	|
79	t3680	0	236	632	|	139	t8040	232	|	238	t9025	131	|
80	t3681	362	91	138	|	96	t5530	232	|	244	t9340	131	|
81	t3690	274	18	266	|	217	t8530	232	|	94	t5380	130	|
82	t4030	377	68	268	|	126	t6890	232	|	229	t8982	130	|
83	t4202	0	236	632	|	215	t8493	229	|	60	t2430	125	|
84	t4203	48	239	111	|	234	t8990	228	|	237	t8999	120	|
85	t4230	-68	221	26	|	221	t8708	227	|	122	t6768	113	|
86	t4248	-67	209	12	|	124	t6810	224	|	245	t9358	113	|
87	t4270	209	-105	-26	|	160	t8352	223	|	155	t8298	112	|
88	t4290	250	-20	449	|	21	t511	223	|	131	t7540	111	|
89	t5030	292	35	137	|	105	t5940	223	|	24	t550	109	|
90	t5090	111	-184	54	|	119	t6740	223	|	56	t2160	106	|
91	t5130	297	16	-25	|	64	t2660	222	|	22	t520	103	|
92	t5240	263	-27	114	|	46	t1440	221	|	198	t8456	103	|
93	t5360	323	148	-193	|	122	t6768	218	|	216	t8520	103	|
94	t5380	367	130	-42	|	95	t5510	217	|	59	t2361	103	|
95	t5510	217	311	149	|	205	t8465	217	|	176	t8410	102	|
96	t5530	232	47	312	|	117	t6650	214	|	169	t8390	100	|
97	t5628	-89	203	76	|	100	t5730	214	|	220	t8630	99	|
98	t5630	257	-15	242	|	104	t5906	214	|	227	t8979	93	|
99	t5660	233	-68	69	|	59	t2361	212	|	210	t8472	92	|
100	t5730	214	-141	205	|	72	t3140	209	|	80	t3681	91	|
101	t5748	-148	3	247	|	74	t3300	209	|	7	t151	91	|
102	t5870	-104	12	-221	|	87	t4270	209	|	141	t8057	83	|
103	t5900	3	-32	250	|	52	t1600	209	|	243	t9310	83	|
104	t5906	214	-141	205	|	240	t9220	209	|	164	t8382	82	|
105	t5940	223	-86	-9	|	106	t5960	208	|	38	t1070	81	|
106	t5960	208	249	0	|	219	t8610	208	|	177	t8411	81	|
107	t6010	281	10	226	|	169	t8390	206	|	109	t6030	81	|
108	t6020	319	36	207	|	130	t7510	202	|	25	t580	80	|
109	t6030	-240	81	119	|	47	t1444	202	|	29	t773	79	|
110	t6060	106	44	167	|	188	t8437	202	|	134	t7610	78	|

111	t6090	120	191	303	|	10	t161	201	|	6	t138	76	|
112	t6118	-78	-52	29	|	207	t8467	196	|	27	t750	74	|
113	t6120	-216	32	306	|	208	t8470	195	|	148	t8130	71	|
114	t6210	190	57	-3	|	161	t8354	190	|	188	t8437	71	|
115	t6312	-106	224	363	|	114	t6210	190	|	17	t278	68	|
116	t6400	171	254	177	|	40	t1115	186	|	82	t4030	68	|
117	t6650	214	-141	205	|	11	t162	183	|	45	t1390	68	|
118	t6680	-115	-222	55	|	157	t8300	182	|	191	t8441	68	|
119	t6740	223	-101	224	|	24	t550	180	|	193	t8444	68	|
120	t6741	-121	16	-198	|	13	t171	176	|	54	t2010	68	|
121	t6743	3	-32	250	|	63	t2628	176	|	65	t2681	63	|
122	t6768	218	113	358	|	60	t2430	175	|	20	t410	60	|
123	t6801	-26	-2	59	|	247	t9380	174	|	33	t1012	59	|
124	t6810	224	215	134	|	168	t8387	173	|	67	t2840	59	|
125	t6851	3	-32	250	|	116	t6400	171	|	37	t1050	57	|
126	t6890	232	43	-198	|	3	t128	163	|	75	t3440	57	|
127	t6894	404	57	147	|	70	t3020	159	|	182	t8419	57	|
128	t6904	96	170	26	|	68	t2901	153	|	114	t6210	57	|
129	t7499	-14	-245	154	|	223	t8730	153	|	127	t6894	57	|
130	t7510	202	195	270	|	53	t1653	151	|	142	t8060	55	|
131	t7540	340	111	208	|	138	t8010	150	|	197	t8454	55	|
132	t7544	-25	286	138	|	173	t8404	146	|	212	t8487	55	|
133	t7560	334	50	204	|	65	t2681	144	|	39	t1094	53	|
134	t7610	243	78	-258	|	145	t8108	144	|	149	t8170	51	|
135	t7768	260	184	300	|	249	t9428	142	|	133	t7560	50	|
136	t7790	-40	207	9	|	143	t8080	141	|	162	t8356	50	|
137	t8008	-179	258	116	|	196	t8453	141	|	28	t757	49	|
138	t8010	150	181	38	|	20	t410	124	|	235	t8993	49	|
139	t8040	232	-148	-69	|	232	t8987	124	|	15	t198	48	|
140	t8050	-115	-222	55	|	29	t773	123	|	175	t8406	48	|
141	t8057	372	83	178	|	111	t6090	120	|	96	t5530	47	|
142	t8060	356	55	157	|	56	t2160	117	|	110	t6060	44	|
143	t8080	141	266	207	|	178	t8412	112	|	12	t164	43	|
144	t8090	0	-55	317	|	90	t5090	111	|	126	t6890	43	|
145	t8108	144	-68	374	|	110	t6060	106	|	14	t189	42	|
146	t8110	333	17	480	|	163	t8358	102	|	211	t8482	42	|
147	t8120	-293	153	269	|	204	t8464	100	|	213	t8488	40	|
148	t8130	-60	71	-174	|	15	t198	99	|	5	t134	39	|
149	t8170	64	51	167	|	190	t8440	98	|	186	t8435	39	|
150	t8178	-121	16	-198	|	175	t8406	97	|	36	t1040	37	|
151	t8180	3	-32	250	|	128	t6904	96	|	108	t6020	36	|

152	t8208	240	168	134	238	t9025	87	89	t5030	35
153	t8219	-198	189	184	26	t651	87	62	t2491	35
154	t8239	25	192	143	191	t8441	86	113	t6120	32
155	t8298	79	112	22	16	t258	85	64	t2660	31
156	t8299	-112	155	458	61	t2460	83	44	t1263	29
157	t8300	182	-35	-30	18	t308	80	73	t3200	28
158	t8315	-106	-224	64	155	t8298	79	234	t8990	25
159	t8340	253	131	173	242	t9290	75	11	t162	24
160	t8352	223	-145	67	14	t189	70	178	t8412	23
161	t8354	190	216	138	185	t8430	69	180	t8415	23
162	t8356	334	50	299	222	t8728	69	61	t2460	22
163	t8358	102	289	216	236	t8994	67	167	t8386	19
164	t8382	239	82	-196	167	t8386	66	81	t3690	18
165	t8383	-79	-198	121	149	t8170	64	146	t8110	17
166	t8385	312	225	-70	186	t8435	63	150	t8178	16
167	t8386	66	19	147	30	t781	59	120	t6741	16
168	t8387	173	-113	250	189	t8438	54	236	t8994	16
169	t8390	206	100	-87	41	t1138	48	252	t9538	16
170	t8392	0	16	98	84	t4203	48	170	t8392	16
171	t8401	292	16	231	253	t9908	46	171	t8401	16
172	t8402	-55	244	-67	6	t138	45	201	t8460	16
173	t8404	146	-151	138	241	t9288	44	91	t5130	16
174	t8405	251	-6	53	187	t8436	40	254	t9950	15
175	t8406	97	48	275	57	t2190	35	102	t5870	12
176	t8410	283	102	153	19	t380	34	70	t3020	10
177	t8411	-240	81	119	1	t8	27	78	t3641	10
178	t8412	112	23	192	154	t8239	25	107	t6010	10
179	t8413	-2	191	357	181	t8416	22	76	t3508	7
180	t8415	-26	23	111	233	t8989	17	222	t8728	7
181	t8416	22	-22	332	39	t1094	17	185	t8430	7
182	t8419	404	57	147	228	t8981	10	199	t8457	6
183	t8421	-37	-194	174	151	t8180	3	77	t3590	3
184	t8427	-64	-233	112	121	t6743	3	101	t5748	3
185	t8430	69	7	113	218	t8560	3	250	t9430	-2
186	t8435	63	39	-8	71	t3071	3	123	t6801	-2
187	t8436	40	197	227	103	t5900	3	221	t8708	-5
188	t8437	202	71	-55	125	t6851	3	174	t8405	-6
189	t8438	54	244	76	66	t2730	0	43	t1240	-7
190	t8440	98	329	157	144	t8090	0	10	t161	-12
191	t8441	86	68	64	170	t8392	0	207	t8467	-12
192	t8443	253	-100	45	79	t3680	0	98	t5630	-15

193	t8444	377	68	268	83	t4202	0	41	t1138	-16
194	t8446	-47	275	286	179	t8413	-2	224	t8734	-16
195	t8450	335	169	13	248	t9390	-10	214	t8490	-16
196	t8453	141	177	-111	129	t7499	-14	203	t8462	-18
197	t8454	-168	55	-34	32	t1011	-14	219	t8610	-18
198	t8456	-273	103	-113	225	t8798	-14	88	t4290	-20
199	t8457	332	6	497	226	t8978	-16	181	t8416	-22
200	t8459	-47	272	2	67	t2840	-18	230	t8984	-26
201	t8460	-121	16	-198	209	t8471	-18	92	t5240	-27
202	t8461	325	215	-62	246	t9370	-20	121	t6743	-32
203	t8462	305	-18	206	8	t153	-23	218	t8560	-32
204	t8464	100	-45	326	132	t7544	-25	71	t3071	-32
205	t8465	217	281	153	239	t9118	-26	103	t5900	-32
206	t8466	241	254	43	123	t6801	-26	151	t8180	-32
207	t8467	196	-12	-129	180	t8415	-26	125	t6851	-32
208	t8470	195	-42	5	4	t130	-27	58	t2351	-35
209	t8471	-18	367	380	237	t8999	-29	157	t8300	-35
210	t8472	244	92	-256	183	t8421	-37	208	t8470	-42
211	t8482	303	42	55	136	t7790	-40	204	t8464	-45
212	t8487	-88	55	-153	9	t155	-42	112	t6118	-52
213	t8488	256	40	76	194	t8446	-47	50	t1530	-53
214	t8490	326	-16	235	200	t8459	-47	144	t8090	-55
215	t8493	229	221	93	172	t8402	-55	241	t9288	-62
216	t8520	-273	103	-113	245	t9358	-55	231	t8986	-63
217	t8530	232	-148	-69	148	t8130	-60	99	t5660	-68
218	t8560	3	-32	250	184	t8427	-64	145	t8108	-68
219	t8610	208	-18	255	86	t4248	-67	51	t1550	-72
220	t8630	246	99	170	85	t4230	-68	34	t1020	-73
221	t8708	227	-5	151	49	t1498	-72	105	t5940	-86
222	t8728	69	7	113	112	t6118	-78	3	t128	-91
223	t8730	153	-171	131	165	t8383	-79	192	t8443	-100
224	t8734	308	-16	146	48	t1445	-81	119	t6740	-101
225	t8798	-14	-245	154	212	t8487	-88	52	t1600	-105
226	t8978	-16	152	-43	97	t5628	-89	72	t3140	-105
227	t8979	-166	93	-44	69	t2925	-103	74	t3300	-105
228	t8981	10	-165	318	102	t5870	-104	87	t4270	-105
229	t8982	328	130	329	158	t8315	-106	240	t9220	-105
230	t8984	249	-26	337	115	t6312	-106	168	t8387	-113
231	t8986	260	-63	33	156	t8299	-112	40	t1115	-122
232	t8987	124	362	74	140	t8050	-115	104	t5906	-141
233	t8989	17	249	451	31	t1010	-115	100	t5730	-141

234	t8990	228	25	74	118	t6680	-115	117	t6650	-141
235	t8993	249	49	-18	150	t8178	-121	46	t1440	-144
236	t8994	67	16	-13	252	t9538	-121	160	t8352	-145
237	t8999	-29	120	-37	120	t6741	-121	217	t8530	-148
238	t9025	87	131	170	201	t8460	-121	139	t8040	-148
239	t9118	-26	199	-29	7	t151	-122	63	t2628	-149
240	t9220	209	-105	-26	244	t9340	-128	173	t8404	-151
241	t9288	44	-62	394	12	t164	-142	228	t8981	-165
242	t9290	75	296	62	101	t5748	-148	223	t8730	-171
243	t9310	372	83	178	227	t8979	-166	90	t5090	-184
244	t9340	-128	131	-57	197	t8454	-168	183	t8421	-194
245	t9358	-55	113	-128	137	t8008	-179	165	t8383	-198
246	t9370	-20	212	-45	153	t8219	-198	118	t6680	-222
247	t9380	174	201	184	113	t6120	-216	31	t1010	-222
248	t9390	-10	197	-26	177	t8411	-240	140	t8050	-222
249	t9428	142	157	-24	109	t6030	-240	158	t8315	-224
250	t9430	309	-2	446	38	t1070	-240	48	t1445	-229
251	t9450	240	270	94	216	t8520	-273	184	t8427	-233
252	t9538	-121	16	-198	198	t8456	-273	129	t7499	-245
253	t9908	46	154	113	22	t520	-273	32	t1011	-245
254	t9950	256	15	59	147	t8120	-293	225	t8798	-245

Spring 2007(Riffle Pool and Glide/Pool)

SAMPLE SCORES - WHICH ARE WEIGHTED MEAN SPECIES SCORES

N	NAME	AX1	AX2	AX3	RANKED 1 EIG=0.305			RANKED 2 EIG=0.228		
1	HC1_00	160	77	85	13	HC1_95	222	20	NF5_GP	239
2	CC1_01	113	67	77	14	HC2_95	212	19	NF1_GP	176
3	CC1_04	198	107	0	3	CC1_04	198	7	NF1_RP	167
4	HC1_07	70	64	100	29	LD1_95	198	25	LD1_07	141
5	CC1_07	57	100	155	30	LD2_95	187	21	NF6_GP	110
6	NF10_RP	33	55	106	1	HC1_00	160	28	NF2_GP	109
7	NF1_RP	143	167	87	31	LD2_98	144	3	CC1_04	107
8	NF6_RP	88	96	85	7	NF1_RP	143	5	CC1_07	100
9	NF9a_RP	33	63	69	32	LD3_98	133	8	NF6_RP	96
10	NF9b_RP	55	63	23	2	CC1_01	113	24	NF8_GP	91

11	NF8_RP	37	88	19	19	NF1_GP	112	|	30	LD2_95	89
12	NF7_RP	70	69	6	8	NF6_RP	88	|	11	NF8_RP	88
13	HC1_95	222	62	108	27	NF3_GP	88	|	27	NF3_GP	86
14	HC2_95	212	73	89	21	NF6_GP	85	|	26	NF7_GP	80
15	LD1_00	74	50	144	20	NF5_GP	74	|	18	NF10_GP	78
16	LD2_01	69	9	132	15	LD1_00	74	|	1	HC1_00	77
17	LD1_01	52	0	112	4	HC1_07	70	|	22	NF9a_GP	74
18	NF10_GP	20	78	114	12	NF7_RP	70	|	14	HC2_95	73
19	NF1_GP	112	176	128	16	LD2_01	69	|	12	NF7_RP	69
20	NF5_GP	74	239	117	5	CC1_07	57	|	23	NF9b_GP	68
21	NF6_GP	85	110	109	10	NF9b_RP	55	|	2	CC1_01	67
22	NF9a_GP	26	74	88	28	NF2_GP	53	|	29	LD1_95	65
23	NF9b_GP	33	68	57	17	LD1_01	52	|	4	HC1_07	64
24	NF8_GP	0	91	52	26	NF7_GP	41	|	9	NF9a_RP	63
25	LD1_07	37	141	62	25	LD1_07	37	|	10	NF9b_RP	63
26	NF7_GP	41	80	48	11	NF8_RP	37	|	13	HC1_95	62
27	NF3_GP	88	86	93	9	NF9a_RP	33	|	6	NF10_RP	55
28	NF2_GP	53	109	63	23	NF9b_GP	33	|	15	LD1_00	50
29	LD1_95	198	65	126	6	NF10_RP	33	|	31	LD2_98	32
30	LD2_95	187	89	149	22	NF9a_GP	26	|	32	LD3_98	29
31	LD2_98	144	32	62	18	NF10_GP	20	|	16	LD2_01	9
32	LD3_98	133	29	106	24	NF8_GP	0	|	17	LD1_01	0

************************** Calculations finished **************************

Appendix C

Detrended Correspondence Analysis (DCA) Comparing the Macroinvertebrate Samples at the NFSR Test Stations to Macroinvertebrate Samples Collected Previously at Sampling Stations Located Within the Biological Criteria Reference Reaches of Cedar Creek, Horse Creek, and Little Drywood Creek. The Data at the NFSR Stations Was Limited to Riffle/Pool Data at NFSR #1 and Glide/Pool Data at the Other NFSR Stations.

```
****************** Detrended Correspondence Analysis (DCA) ******************
PC-ORD, Version 4.14
19 Feb 2008, 15:09

Fall 2006 (Riffle Pool at NFSR #1, Glide/Pool at other NFSR Stations)
Number of non-zero data items:     1805

No downweighting
Axes are rescaled
Number of segments: 30
Threshold:  0.00



Total variance ("inertia") in the species data:   2.4505


                    ---------- Axis 1 ----------

 0.1405817419 = residual at iteration   0
 0.0067928359 = residual at iteration   1
 0.0000825539 = residual at iteration   2
 0.0000011094 = residual at iteration   3
 0.0000000776 = residual at iteration   4
 0.4651609361 = eigen value


Length of gradient:     2.497
Length of segments:  0.28  0.27  0.25  0.24  0.22  0.20  0.18  0.17  0.16  0.15
Length of segments:  0.14  0.13  0.12
Length of gradient:     2.693


Length of gradient:     2.684
Length of segments:  0.20  0.20  0.19  0.19  0.19  0.19  0.19  0.20  0.19  0.19
Length of segments:  0.19  0.19  0.19  0.18
Length of gradient:     2.675
```

```
---------- Axis 2 ----------

0.0494089164 = residual at iteration   0
0.0274297465 = residual at iteration   1
0.0036148836 = residual at iteration   2
0.0003256735 = residual at iteration   3
0.0000433734 = residual at iteration   4
0.0000039899 = residual at iteration   5
0.0000005452 = residual at iteration   6
0.0000001973 = residual at iteration   7
0.0587216206 = residual at iteration   8
0.0030730232 = residual at iteration   9
0.0003108132 = residual at iteration  10
0.0000206210 = residual at iteration  11
0.0000024918 = residual at iteration  12
0.0000002003 = residual at iteration  13
0.0000002028 = residual at iteration  14
0.0496821739 = residual at iteration  15
0.0174235143 = residual at iteration  16
0.0014191251 = residual at iteration  17
0.0001802565 = residual at iteration  18
0.0000164085 = residual at iteration  19
0.0000021614 = residual at iteration  20
0.0000002214 = residual at iteration  21
0.0342122614 = residual at iteration  22
0.0379280709 = residual at iteration  23
0.0038363794 = residual at iteration  24
0.0004552122 = residual at iteration  25
0.0000405775 = residual at iteration  26
0.0000051330 = residual at iteration  27
0.0000005046 = residual at iteration  28
0.0000004038 = residual at iteration  29
0.0000001411 = residual at iteration  30
0.0676115453 = residual at iteration  31
0.0076827402 = residual at iteration  32
0.0007274991 = residual at iteration  33
0.0000853089 = residual at iteration  34
0.0000106374 = residual at iteration  35
0.0000013638 = residual at iteration  36
0.0000001951 = residual at iteration  37
0.0000001093 = residual at iteration  38
```

```
 0.0436502136 = residual at iteration  39
 0.0006611393 = residual at iteration  40
 0.0000286053 = residual at iteration  41
 0.0000031208 = residual at iteration  42
 0.0000002673 = residual at iteration  43
 0.0400963351 = residual at iteration  44
 0.0272223372 = residual at iteration  45
 0.0025952584 = residual at iteration  46
 0.0003042419 = residual at iteration  47
 0.0000275201 = residual at iteration  48
 0.0000032631 = residual at iteration  49
 0.0000002944 = residual at iteration  50
 0.0028093150 = residual at iteration  60
 0.0000874962 = residual at iteration  70
 0.0000008516 = residual at iteration  80
 0.0000083980 = residual at iteration  90
 0.0000003779 = residual at iteration 100
 0.0014637875 = residual at iteration 110
 0.0000265969 = residual at iteration 120
 0.0534274355 = residual at iteration 130
 0.0000063972 = residual at iteration 140
 0.0246373862 = residual at iteration 150
 0.0060916040 = residual at iteration 160
 0.0000464905 = residual at iteration 170
 0.0000007045 = residual at iteration 180
 0.0011650383 = residual at iteration 190
 0.0000001827 = residual at iteration 200
 0.0094924485 = residual at iteration 210
 0.0000025772 = residual at iteration 220
 0.0028366041 = residual at iteration 230
 0.0000251338 = residual at iteration 240
 0.0000000864 = residual at iteration 243
 0.2029508203 = eigen value


Length of gradient:     2.104
Length of segments:  0.14  0.16  0.19  0.22  0.23  0.22  0.22  0.21  0.19  0.17
Length of segments:  0.15
Length of gradient:     2.120
```

```
Length of gradient:     2.082
Length of segments:  0.17  0.18  0.19  0.21  0.21  0.20  0.20  0.20  0.19  0.18
Length of segments:  0.17
Length of gradient:     2.073


                    ---------- Axis 3 ----------

 0.0366956145 = residual at iteration   0
 0.0057897535 = residual at iteration   1
 0.0007512598 = residual at iteration   2
 0.0000697104 = residual at iteration   3
 0.0000125697 = residual at iteration   4
 0.0000012551 = residual at iteration   5
 0.0000002394 = residual at iteration   6
 0.0000000476 = residual at iteration   7
 0.1050830632 = eigen value


Length of gradient:     1.451
Length of segments:  0.16  0.17  0.18  0.18  0.19  0.19  0.16  0.10  0.07  0.06
Length of gradient:     1.807


Length of gradient:     1.785
Length of segments:  0.16  0.16  0.18  0.19  0.19  0.20  0.20  0.19  0.17  0.15
Length of gradient:     1.758




Fall 2006 (Riffle Pool at NFSR #1, Glide/Pool at other NFSR Stations)

SPECIES SCORES

    N    NAME     AX1  AX2  AX3      |       RANKED 1      |       RANKED 2
                                     |      EIG=0.465      |      EIG=0.203      |
     1 t8         170   52  -24      |    40 t1268     390 |    68 t2800     528 |
     2 t128       119  181  240      |    93 t5063     390 |   160 t8411     528 |
     3 t130        68  148  -78      |    48 t2010     390 |   198 t8560     528 |
     4 t134       -47  320 -151      |   159 t8410     379 |   117 t6560     528 |
```

5	t138	74	196	-6	|	134	t7560	372	|	107	t6030	435	|
6	t151	-57	292	28	|	95	t5130	365	|	186	t8468	389	|
7	t153	-107	-171	7	|	90	t5030	361	|	214	t8999	334	|
8	t155	-54	72	49	|	194	t8490	359	|	199	t8608	330	|
9	t161	219	11	-148	|	203	t8730	357	|	219	t9290	323	|
10	t162	105	156	-48	|	151	t8356	356	|	4	t134	320	|
11	t171	-46	-125	-44	|	49	t2020	352	|	53	t2328	313	|
12	t189	-32	-13	227	|	138	t8060	351	|	197	t8528	306	|
13	t198	132	219	61	|	41	t1390	351	|	100	t5508	306	|
14	t258	25	148	-36	|	36	t1180	338	|	144	t8209	292	|
15	t278	-54	264	197	|	29	t1040	335	|	6	t151	292	|
16	t288	177	0	-219	|	147	t8300	334	|	157	t8404	289	|
17	t308	34	98	-1	|	65	t2690	323	|	43	t1498	288	|
18	t380	-57	272	-156	|	34	t1123	323	|	124	t6741	279	|
19	t511	137	-7	0	|	139	t8070	323	|	111	t6180	278	|
20	t550	-149	263	194	|	75	t4050	323	|	64	t2681	276	|
21	t651	24	217	-8	|	38	t1260	323	|	18	t380	272	|
22	t750	-44	-18	164	|	98	t5400	323	|	229	t9908	269	|
23	t757	235	149	272	|	228	t9538	315	|	125	t6743	269	|
24	t762	213	26	-191	|	45	t1550	311	|	225	t9428	264	|
25	t773	164	222	207	|	39	t1263	301	|	15	t278	264	|
26	t781	20	214	167	|	31	t1050	300	|	20	t550	263	|
27	t1028	-16	224	-160	|	180	t8461	295	|	110	t6130	263	|
28	t1030	222	37	-183	|	94	t5070	285	|	69	t2840	259	|
29	t1040	335	103	29	|	171	t8443	283	|	205	t8798	258	|
30	t1046	235	8	-95	|	101	t5660	282	|	224	t9390	256	|
31	t1050	300	58	-20	|	150	t8354	281	|	59	t2460	254	|
32	t1070	36	0	0	|	106	t6020	280	|	216	t9118	252	|
33	t1115	271	124	230	|	73	t3510	275	|	89	t4370	250	|
34	t1123	323	104	59	|	91	t5058	275	|	185	t8467	246	|
35	t1138	211	50	-57	|	184	t8466	275	|	112	t6210	246	|
36	t1180	338	82	-39	|	96	t5160	275	|	161	t8413	239	|
37	t1240	232	138	177	|	210	t8990	275	|	201	t8630	235	|
38	t1260	323	104	59	|	217	t9220	275	|	162	t8415	232	|
39	t1263	301	140	180	|	33	t1115	271	|	172	t8446	232	|
40	t1268	390	104	59	|	195	t8491	271	|	131	t6904	231	|
41	t1390	351	90	55	|	154	t8385	270	|	136	t7768	231	|
42	t1444	114	118	228	|	177	t8457	264	|	207	t8984	231	|
43	t1498	56	288	204	|	163	t8416	261	|	123	t6740	231	|
44	t1500	232	165	344	|	181	t8462	259	|	62	t2650	231	|
45	t1550	311	143	96	|	175	t8453	252	|	222	t9370	229	|

46	t1650	146	183	398	|	60	t2491	251 |	27	t1028	224 |
47	t1653	42	-72	-47	|	63	t2660	251 |	25	t773	222 |
48	t2010	390	104	59	|	226	t9430	250 |	142	t8140	221 |
49	t2020	352	74	55	|	74	t4030	248 |	13	t198	219 |
50	t2120	246	129	148	|	50	t2120	246 |	21	t651	217 |
51	t2160	227	111	127	|	227	t9450	242 |	221	t9340	217 |
52	t2190	-73	198	171	|	124	t6741	241 |	79	t4200	216 |
53	t2328	74	313	233	|	135	t7610	240 |	174	t8451	216 |
54	t2351	95	181	205	|	148	t8340	239 |	187	t8469	216 |
55	t2353	220	205	-276	|	125	t6743	237 |	84	t4210	214 |
56	t2361	32	147	-72	|	127	t6801	236 |	26	t781	214 |
57	t2408	26	-64	338	|	23	t757	235 |	132	t7510	212 |
58	t2430	-45	136	242	|	30	t1046	235 |	103	t5940	211 |
59	t2460	133	254	57	|	104	t5960	233 |	164	t8430	208 |
60	t2491	251	155	305	|	37	t1240	232 |	55	t2353	205 |
61	t2628	-55	-64	128	|	44	t1500	232 |	141	t8130	202 |
62	t2650	168	231	503	|	130	t6890	231 |	52	t2190	198 |
63	t2660	251	110	265	|	193	t8488	229 |	165	t8435	196 |
64	t2681	-14	276	-13	|	97	t5360	229 |	5	t138	196 |
65	t2690	323	104	59	|	129	t6851	228 |	230	t9950	196 |
66	t2730	-68	-24	151	|	156	t8402	227 |	204	t8750	193 |
67	t2750	114	119	209	|	51	t2160	227 |	223	t9380	193 |
68	t2800	-177	528	4	|	155	t8386	225 |	173	t8450	192 |
69	t2840	20	259	-100	|	190	t8472	224 |	182	t8464	192 |
70	t2901	-78	139	-16	|	179	t8460	222 |	190	t8472	191 |
71	t2920	63	170	209	|	28	t1030	222 |	129	t6851	185 |
72	t2925	-96	-97	159	|	196	t8493	221 |	181	t8462	185 |
73	t3510	275	20	47	|	128	t6810	220 |	149	t8352	184 |
74	t4030	248	89	183	|	55	t2353	220 |	83	t4204	184 |
75	t4050	323	104	59	|	9	t161	219 |	177	t8457	184 |
76	t4110	160	-24	26	|	24	t762	213 |	116	t6480	184 |
77	t4140	201	-40	-4	|	35	t1138	211 |	46	t1650	183 |
78	t4170	-64	34	122	|	77	t4140	201 |	166	t8436	182 |
79	t4200	197	216	271	|	79	t4200	197 |	120	t6680	182 |
80	t4201	-43	7	218	|	174	t8451	197 |	2	t128	181 |
81	t4202	-76	-93	146	|	187	t8469	197 |	101	t5660	181 |
82	t4203	-72	121	-228	|	103	t5940	196 |	54	t2351	181 |
83	t4204	-52	184	43	|	208	t8987	196 |	106	t6020	179 |
84	t4210	-167	214	14	|	167	t8437	190 |	195	t8491	177 |
85	t4230	-7	35	187	|	192	t8482	181 |	94	t5070	175 |
86	t4248	47	106	-223	|	16	t288	177 |	71	t2920	170 |

87	t4266	103	-42	-123	153	t8382	177	150	t8354	169	
88	t4290	108	147	-28	211	t8991	177	226	t9430	166	
89	t4370	-15	250	-80	114	t6312	177	44	t1500	165	
90	t5030	361	102	58	121	t6721	177	127	t6801	163	
91	t5058	275	20	47	122	t6726	177	148	t8340	160	
92	t5061	36	-3	119	137	t8010	174	10	t162	156	
93	t5063	390	104	59	201	t8630	174	60	t2491	155	
94	t5070	285	175	57	200	t8610	171	23	t757	149	
95	t5130	365	98	45	1	t8	170	168	t8438	148	
96	t5160	275	20	47	105	t6010	169	210	t8990	148	
97	t5360	229	3	-98	131	t6904	168	3	t130	148	
98	t5400	323	104	59	136	t7768	168	14	t258	148	
99	t5440	22	-29	115	207	t8984	168	56	t2361	147	
100	t5508	-130	306	-229	123	t6740	168	88	t4290	147	
101	t5660	282	181	66	62	t2650	168	45	t1550	143	
102	t5868	-45	136	242	230	t9950	166	39	t1263	140	
103	t5940	196	211	261	183	t8465	165	70	t2901	139	
104	t5960	233	85	191	25	t773	164	37	t1240	138	
105	t6010	169	25	-67	170	t8441	161	170	t8441	138	
106	t6020	280	179	43	76	t4110	160	192	t8482	137	
107	t6030	-141	435	-192	213	t8994	156	128	t6810	136	
108	t6090	-41	-118	-60	115	t6400	151	191	t8474	136	
109	t6118	-66	107	175	111	t6180	148	220	t9310	136	
110	t6130	-149	263	194	141	t8130	147	102	t5868	136	
111	t6180	148	278	252	223	t9380	147	202	t8640	136	
112	t6210	42	246	-64	46	t1650	146	58	t2430	136	
113	t6310	-18	-71	204	176	t8454	138	171	t8443	135	
114	t6312	177	0	-219	19	t511	137	215	t9025	133	
115	t6400	151	-3	-166	59	t2460	133	213	t8994	133	
116	t6480	87	184	160	13	t198	132	50	t2120	129	
117	t6560	-177	528	4	2	t128	119	33	t1115	124	
118	t6580	24	-15	-27	165	t8435	117	163	t8416	121	
119	t6650	57	-68	226	67	t2750	114	82	t4203	121	
120	t6680	-40	182	-24	42	t1444	114	67	t2750	119	
121	t6721	177	0	-219	88	t4290	108	176	t8454	119	
122	t6726	177	0	-219	10	t162	105	42	t1444	118	
123	t6740	168	231	503	87	t4266	103	156	t8402	116	
124	t6741	241	279	-48	54	t2351	95	184	t8466	113	
125	t6743	237	269	5	173	t8450	94	51	t2160	111	
126	t6768	21	-21	158	149	t8352	87	63	t2660	110	
127	t6801	236	163	177	116	t6480	87	146	t8239	108	

128	t6810	220	136	12	182	t8464	87	109	t6118	107
129	t6851	228	185	367	215	t9025	84	86	t4248	106
130	t6890	231	36	-130	5	t138	74	65	t2690	104
131	t6904	168	231	503	53	t2328	74	34	t1123	104
132	t7510	47	212	74	204	t8750	72	139	t8070	104
133	t7544	-90	-59	204	3	t130	68	75	t4050	104
134	t7560	372	96	31	71	t2920	63	38	t1260	104
135	t7610	240	18	83	119	t6650	57	159	t8410	104
136	t7768	168	231	503	43	t1498	56	40	t1268	104
137	t8010	174	60	112	132	t7510	47	93	t5063	104
138	t8060	351	83	56	229	t9908	47	48	t2010	104
139	t8070	323	104	59	86	t4248	47	98	t5400	104
140	t8120	-50	89	242	189	t8471	43	29	t1040	103
141	t8130	147	202	181	47	t1653	42	90	t5030	102
142	t8140	28	221	60	112	t6210	42	194	t8490	101
143	t8170	-64	-23	217	32	t1070	36	17	t308	98
144	t8209	-98	292	113	92	t5061	36	95	t5130	98
145	t8219	-71	-100	86	17	t308	34	154	t8385	97
146	t8239	10	108	5	56	t2361	32	134	t7560	96
147	t8300	334	71	-45	142	t8140	28	203	t8730	92
148	t8340	239	160	177	57	t2408	26	151	t8356	91
149	t8352	87	184	160	14	t258	25	41	t1390	90
150	t8354	281	169	-132	118	t6580	24	140	t8120	89
151	t8356	356	91	58	21	t651	24	74	t4030	89
152	t8358	-15	85	158	99	t5440	22	152	t8358	85
153	t8382	177	0	-219	221	t9340	21	104	t5960	85
154	t8385	270	97	-116	126	t6768	21	138	t8060	83
155	t8386	225	65	-95	69	t2840	20	200	t8610	83
156	t8402	227	116	57	26	t781	20	212	t8993	82
157	t8404	-63	289	11	168	t8438	19	36	t1180	82
158	t8406	-18	-71	204	146	t8239	10	228	t9538	82
159	t8410	379	104	59	185	t8467	9	49	t2020	74
160	t8411	-177	528	4	85	t4230	-7	178	t8459	73
161	t8413	-51	239	-58	64	t2681	-14	8	t155	72
162	t8415	-143	232	180	152	t8358	-15	147	t8300	71
163	t8416	261	121	-62	89	t4370	-15	155	t8386	65
164	t8430	-87	208	186	27	t1028	-16	175	t8453	61
165	t8435	117	196	7	113	t6310	-18	193	t8488	61
166	t8436	-27	182	105	158	t8406	-18	137	t8010	60
167	t8437	190	59	123	188	t8470	-20	167	t8437	59
168	t8438	19	148	84	166	t8436	-27	31	t1050	58

169	t8440	-63	5	116	|	222	t9370	-27	|	1	t8	52	|
170	t8441	161	138	259	|	218	t9288	-28	|	35	t1138	50	|
171	t8443	283	135	215	|	12	t189	-32	|	180	t8461	44	|
172	t8446	-70	232	187	|	216	t9118	-39	|	179	t8460	37	|
173	t8450	94	192	221	|	120	t6680	-40	|	28	t1030	37	|
174	t8451	197	216	271	|	108	t6090	-41	|	130	t6890	36	|
175	t8453	252	61	7	|	80	t4201	-43	|	85	t4230	35	|
176	t8454	138	119	-16	|	22	t750	-44	|	78	t4170	34	|
177	t8457	264	184	85	|	220	t9310	-45	|	196	t8493	34	|
178	t8459	-45	73	80	|	102	t5868	-45	|	208	t8987	32	|
179	t8460	222	37	-183	|	191	t8474	-45	|	227	t9450	31	|
180	t8461	295	44	-36	|	178	t8459	-45	|	24	t762	26	|
181	t8462	259	185	143	|	202	t8640	-45	|	105	t6010	25	|
182	t8464	87	192	203	|	58	t2430	-45	|	209	t8989	24	|
183	t8465	165	-38	99	|	11	t171	-46	|	96	t5160	20	|
184	t8466	275	113	171	|	4	t134	-47	|	91	t5058	20	|
185	t8467	9	246	241	|	140	t8120	-50	|	73	t3510	20	|
186	t8468	-118	389	-8	|	224	t9390	-51	|	217	t9220	20	|
187	t8469	197	216	271	|	161	t8413	-51	|	135	t7610	18	|
188	t8470	-20	-3	176	|	83	t4204	-52	|	9	t161	11	|
189	t8471	43	-22	10	|	15	t278	-54	|	30	t1046	8	|
190	t8472	224	191	280	|	8	t155	-54	|	80	t4201	7	|
191	t8474	-45	136	242	|	61	t2628	-55	|	169	t8440	5	|
192	t8482	181	137	227	|	18	t380	-57	|	97	t5360	3	|
193	t8488	229	61	127	|	6	t151	-57	|	32	t1070	0	|
194	t8490	359	101	76	|	205	t8798	-61	|	114	t6312	0	|
195	t8491	271	177	229	|	169	t8440	-63	|	16	t288	0	|
196	t8493	221	34	132	|	225	t9428	-63	|	153	t8382	0	|
197	t8528	-130	306	-229	|	157	t8404	-63	|	122	t6726	0	|
198	t8560	-177	528	4	|	143	t8170	-64	|	211	t8991	0	|
199	t8608	-91	330	-264	|	78	t4170	-64	|	121	t6721	0	|
200	t8610	171	83	218	|	206	t8978	-64	|	92	t5061	-3	|
201	t8630	174	235	-92	|	109	t6118	-66	|	188	t8470	-3	|
202	t8640	-45	136	242	|	66	t2730	-68	|	115	t6400	-3	|
203	t8730	357	92	57	|	209	t8989	-69	|	19	t511	-7	|
204	t8750	72	193	162	|	172	t8446	-70	|	12	t189	-13	|
205	t8798	-61	258	-24	|	145	t8219	-71	|	118	t6580	-15	|
206	t8978	-64	-37	172	|	82	t4203	-72	|	218	t9288	-17	|
207	t8984	168	231	503	|	52	t2190	-73	|	22	t750	-18	|
208	t8987	196	32	-1	|	81	t4202	-76	|	126	t6768	-21	|
209	t8989	-69	24	101	|	70	t2901	-78	|	189	t8471	-22	|

210	t8990	275	148	176	164	t8430	-87	143	t8170	-23
211	t8991	177	0	-219	133	t7544	-90	76	t4110	-24
212	t8993	-156	82	312	199	t8608	-91	66	t2730	-24
213	t8994	156	133	-23	72	t2925	-96	99	t5440	-29
214	t8999	-98	334	196	144	t8209	-98	206	t8978	-37
215	t9025	84	133	66	214	t8999	-98	183	t8465	-38
216	t9118	-39	252	-36	7	t153	-107	77	t4140	-40
217	t9220	275	20	47	186	t8468	-118	87	t4266	-42
218	t9288	-28	-17	131	100	t5508	-130	133	t7544	-59
219	t9290	-153	323	96	197	t8528	-130	61	t2628	-64
220	t9310	-45	136	242	107	t6030	-141	57	t2408	-64
221	t9340	21	217	8	162	t8415	-143	119	t6650	-68
222	t9370	-27	229	144	20	t550	-149	158	t8406	-71
223	t9380	147	193	208	110	t6130	-149	113	t6310	-71
224	t9390	-51	256	-103	219	t9290	-153	47	t1653	-72
225	t9428	-63	264	46	212	t8993	-156	81	t4202	-93
226	t9430	250	166	225	84	t4210	-167	72	t2925	-97
227	t9450	242	31	-112	160	t8411	-177	145	t8219	-100
228	t9538	315	82	-39	117	t6560	-177	108	t6090	-118
229	t9908	47	269	-9	68	t2800	-177	11	t171	-125
230	t9950	166	196	426	198	t8560	-177	7	t153	-171

Fall 2006 (Riffle Pool at NFSR #1, Glide/Pool at other NFSR Stations)

SAMPLE SCORES - WHICH ARE WEIGHTED MEAN SPECIES SCORES

N	NAME	AX1	AX2	AX3	RANKED 1			RANKED 2		
					EIG=0.465			EIG=0.203		
1	HC1_00	138	129	175	7	HC1_95	267	24	NF10_GP	207
2	CC1_01	188	84	58	8	HC2_95	227	10	LD4_03	182
3	CC1_03	157	96	21	25	LD1_95	202	27	LD2_98	147
4	NF1_RP	127	73	0	26	LD2_95	198	23	NF9_GP	142
5	HC1_06	80	113	81	2	CC1_01	188	12	LD3_03	141
6	CC1_06	72	120	32	3	CC1_03	157	26	LD2_95	137
7	HC1_95	267	92	66	9	LD1_00	144	25	LD1_95	135
8	HC2_95	227	95	80	1	HC1_00	138	11	LD2_03	133
9	LD1_00	144	129	155	4	NF1_RP	127	9	LD1_00	129
10	LD4_03	25	182	71	27	LD2_98	86	1	HC1_00	129

11	LD2_03	43	133	3	|	5	HC1_06	80 |	20	NF6_GP	124 |
12	LD3_03	19	141	35	|	6	CC1_06	72 |	6	CC1_06	120 |
13	LD1_06	36	106	84	|	20	NF6_GP	66 |	22	NF8_GP	119 |
14	LD2_06	4	77	125	|	16	NF3_GP	57 |	5	HC1_06	113 |
15	NF2_GP	54	52	94	|	15	NF2_GP	54 |	21	NF7_GP	106 |
16	NF3_GP	57	40	77	|	21	NF7_GP	46 |	13	LD1_06	106 |
17	NF4a_GP	4	0	72	|	28	LD3_98	44 |	28	LD3_98	100 |
18	NF5_GP	22	34	79	|	11	LD2_03	43 |	3	CC1_03	96 |
19	NF4b_GP	2	1	65	|	23	NF9_GP	41 |	8	HC2_95	95 |
20	NF6_GP	66	124	93	|	13	LD1_06	36 |	7	HC1_95	92 |
21	NF7_GP	46	106	101	|	10	LD4_03	25 |	2	CC1_01	84 |
22	NF8_GP	9	119	103	|	18	NF5_GP	22 |	14	LD2_06	77 |
23	NF9_GP	41	142	93	|	12	LD3_03	19 |	4	NF1_RP	73 |
24	NF10_GP	0	207	45	|	22	NF8_GP	9 |	15	NF2_GP	52 |
25	LD1_95	202	135	101	|	14	LD2_06	4 |	16	NF3_GP	40 |
26	LD2_95	198	137	95	|	17	NF4a_GP	4 |	18	NF5_GP	34 |
27	LD2_98	86	147	69	|	19	NF4b_GP	2 |	19	NF4b_GP	1 |
28	LD3_98	44	100	120	|	24	NF10_GP	0 |	17	NF4a_GP	0 |

************************** Calculations finished **************************

```
****************** Detrended Correspondence Analysis (DCA) ******************
PC-ORD, Version 4.14
19 Feb 2008, 15:15

Spring 2007(Riffle/Pool at NFSR #1 and Glide/Pool at other NFSR Stations)
Number of non-zero data items:     1583

No downweighting
Axes are rescaled
Number of segments: 30
Threshold:  0.00



Total variance ("inertia") in the species data:   2.4720


                    ---------- Axis 1 ----------

 0.1281589121 = residual at iteration   0
 0.0216064379 = residual at iteration   1
 0.0015270280 = residual at iteration   2
 0.0000868732 = residual at iteration   3
 0.0000078389 = residual at iteration   4
 0.0000004904 = residual at iteration   5
 0.0000000751 = residual at iteration   6
 0.3392611444 = eigen value


Length of gradient:     1.992
Length of segments:  0.27  0.27  0.25  0.23  0.20  0.18  0.16  0.15  0.14  0.14
Length of gradient:     2.127


Length of gradient:     2.187
Length of segments:  0.21  0.21  0.21  0.21  0.21  0.21  0.19  0.18  0.18  0.18
Length of segments:  0.18
Length of gradient:     2.185
```

```
                    ---------- Axis 2 ----------

 0.0622753687 = residual at iteration   0
 0.0077132210 = residual at iteration   1
 0.0092607271 = residual at iteration   2
 0.0003674131 = residual at iteration   3
 0.0001050809 = residual at iteration   4
 0.0000114216 = residual at iteration   5
 0.0000033674 = residual at iteration   6
 0.0000003846 = residual at iteration   7
 0.0000001872 = residual at iteration   8
 0.0000000428 = residual at iteration   9
 0.1946571171 = eigen value


Length of gradient:     1.983
Length of segments:  0.15  0.19  0.23  0.26  0.26  0.24  0.21  0.17  0.14  0.13
Length of gradient:     1.999


Length of gradient:     1.936
Length of segments:  0.16  0.18  0.20  0.21  0.22  0.23  0.22  0.19  0.17  0.16
Length of gradient:     1.882


                    ---------- Axis 3 ----------

 0.0395618193 = residual at iteration   0
 0.0054956744 = residual at iteration   1
 0.0027968273 = residual at iteration   2
 0.0001141592 = residual at iteration   3
 0.0000379630 = residual at iteration   4
 0.0000056655 = residual at iteration   5
 0.0000022047 = residual at iteration   6
 0.0000003419 = residual at iteration   7
 0.0000001650 = residual at iteration   8
 0.0000000224 = residual at iteration   9
 0.1046127528 = eigen value
```

```
Length of gradient:     1.526
Length of segments:  0.16  0.18  0.19  0.19  0.19  0.17  0.14  0.11  0.09  0.09
Length of gradient:     1.639


Length of gradient:     1.619
Length of segments:  0.14  0.16  0.17  0.18  0.18  0.18  0.17  0.16  0.15  0.14
Length of gradient:     1.597
```

Spring 2007(Riffle/Pool at NFSR #1 and Glide/Pool at other NFSR Stations)

SPECIES SCORES

```
    N    NAME     AX1  AX2  AX3      |       RANKED 1       |       RANKED 2
                                     |      EIG=0.339       |      EIG=0.195       |
     1 t8        -112  -24  173      |     2 t108       387 |    37 t1050     459 |
     2 t108       387 -269   41      |    42 t1180      387 |    75 t3440     459 |
     3 t128       115  158  227      |    23 t540       387 |   182 t8419     459 |
     4 t130      -199  -31  175      |    25 t580       378 |   127 t6894     459 |
     5 t134       307 -169  198      |    94 t5380      375 |    33 t1012     437 |
     6 t138        92   89  140      |    37 t1050      369 |   141 t8057     402 |
     7 t151       -78   85  106      |    75 t3440      369 |   243 t9310     402 |
     8 t153       -76  -29  171      |   182 t8419      369 |    76 t3508     386 |
     9 t155       -55    0   26      |   127 t6894      369 |    78 t3641     376 |
    10 t161       164  193  169      |    33 t1012      366 |    36 t1040     361 |
    11 t162       183  181   76      |    93 t5360      359 |    17 t278      351 |
    12 t164      -101   85   -3      |    17 t278       356 |    82 t4030     351 |
    13 t171       151  -53  -12      |    82 t4030      356 |    45 t1390     351 |
    14 t189        96   22  110      |    45 t1390      356 |   193 t8444     351 |
    15 t198       145  -15  183      |   193 t8444      356 |    54 t2010     351 |
    16 t258        20  -35   93      |    54 t2010      356 |   131 t7540     344 |
    17 t278       356  351  199      |   166 t8385      345 |   176 t8410     344 |
    18 t308       113  -25  105      |    80 t3681      341 |    27 t750      339 |
    19 t380       -24  177  -15      |   162 t8356      341 |   214 t8490     334 |
    20 t410       286 -180   29      |   142 t8060      337 |   171 t8401     326 |
    21 t511       210  -16  -40      |   202 t8461      337 |   229 t8982     322 |
    22 t520      -237   76  207      |    78 t3641      334 |   108 t6020     321 |
    23 t540       387 -269   41      |    36 t1040      333 |    80 t3681     320 |
```

24	t550	154	19	-61	73	t3200	331	73	t3200	315
25	t580	378	198	41	126	t6890	330	139	t8040	305
26	t651	-22	222	15	141	t8057	328	217	t8530	305
27	t750	295	339	203	243	t9310	328	142	t8060	304
28	t757	264	-151	200	195	t8450	323	192	t8443	292
29	t773	100	126	122	76	t3508	322	64	t2660	291
30	t781	-42	28	-118	133	t7560	321	146	t8110	282
31	t1010	-94	253	-303	35	t1030	320	221	t8708	279
32	t1011	-37	238	-315	211	t8482	311	107	t6010	276
33	t1012	366	437	104	5	t134	307	98	t5630	271
34	t1020	227	-27	118	229	t8982	301	203	t8462	267
35	t1030	320	-145	-55	91	t5130	298	224	t8734	266
36	t1040	333	361	147	199	t8457	298	161	t8354	264
37	t1050	369	459	41	27	t750	295	92	t5240	263
38	t1070	-165	38	190	134	t7610	294	199	t8457	263
39	t1094	-22	-9	307	44	t1263	293	208	t8470	261
40	t1115	104	192	253	210	t8472	293	81	t3690	260
41	t1138	44	128	-235	214	t8490	293	160	t8352	256
42	t1180	387	-269	41	146	t8110	291	140	t8050	253
43	t1240	270	200	245	224	t8734	291	58	t2351	253
44	t1263	293	188	-8	250	t9430	291	118	t6680	253
45	t1390	356	351	199	131	t7540	287	31	t1010	253
46	t1440	176	245	182	176	t8410	287	158	t8315	252
47	t1444	195	64	42	20	t410	286	152	t8208	251
48	t1445	-75	248	-307	89	t5030	286	48	t1445	248
49	t1498	-167	10	34	62	t2491	286	184	t8427	246
50	t1530	204	197	264	171	t8401	279	46	t1440	245
51	t1550	235	138	158	203	t8462	275	135	t7768	244
52	t1600	203	-9	-43	174	t8405	274	129	t7499	238
53	t1653	121	5	-89	43	t1240	270	32	t1011	238
54	t2010	356	351	199	164	t8382	269	133	t7560	238
55	t2120	227	206	177	108	t6020	268	225	t8798	238
56	t2160	142	24	141	28	t757	264	173	t8404	237
57	t2190	-8	-21	-47	235	t8993	264	88	t4290	237
58	t2351	231	253	-72	77	t3590	262	165	t8383	234
59	t2361	192	197	191	92	t5240	251	157	t8300	232
60	t2430	176	-14	-193	213	t8488	249	195	t8450	228
61	t2460	137	171	180	254	t9950	249	219	t8610	227
62	t2491	286	-53	-236	81	t3690	248	183	t8421	223
63	t2628	116	209	-19	107	t6010	248	26	t651	222
64	t2660	213	291	157	231	t8986	248	168	t8387	220

65	t2681	174	81	174	159	t8340	246	96	t5530	220
66	t2730	-22	-50	149	196	t8453	246	97	t5628	218
67	t2840	-23	104	-41	251	t9450	239	119	t6740	217
68	t2901	43	-40	77	220	t8630	238	231	t8986	216
69	t2925	-175	9	251	188	t8437	237	230	t8984	214
70	t3020	214	-78	-14	206	t8466	237	223	t8730	213
71	t3071	55	-33	253	95	t5510	236	112	t6118	212
72	t3140	203	-9	-43	51	t1550	235	228	t8981	209
73	t3200	331	315	-20	215	t8493	231	63	t2628	209
74	t3300	203	-9	-43	58	t2351	231	137	t8008	207
75	t3440	369	459	41	34	t1020	227	174	t8405	207
76	t3508	322	386	195	55	t2120	227	234	t8990	207
77	t3590	262	-68	3	169	t8390	225	90	t5090	206
78	t3641	334	376	69	124	t6810	223	110	t6060	206
79	t3680	-22	-50	149	128	t6904	222	55	t2120	206
80	t3681	341	320	-33	135	t7768	221	100	t5730	204
81	t3690	248	260	26	99	t5660	220	104	t5906	204
82	t4030	356	351	199	230	t8984	220	117	t6650	204
83	t4202	-22	-50	149	221	t8708	219	122	t6768	204
84	t4203	-53	13	183	192	t8443	217	211	t8482	201
85	t4230	-97	123	39	105	t5940	216	43	t1240	200
86	t4248	-79	44	46	70	t3020	214	130	t7510	199
87	t4270	203	-9	-43	64	t2660	213	169	t8390	198
88	t4290	209	237	400	98	t5630	213	25	t580	198
89	t5030	286	-53	-236	21	t511	210	50	t1530	197
90	t5090	93	206	-204	88	t4290	209	59	t2361	197
91	t5130	298	-42	201	234	t8990	208	138	t8010	193
92	t5240	251	263	56	139	t8040	207	10	t161	193
93	t5360	359	-232	15	106	t5960	207	40	t1115	192
94	t5380	375	95	118	217	t8530	207	44	t1263	188
95	t5510	236	-96	-52	152	t8208	205	11	t162	181
96	t5530	189	220	205	50	t1530	204	132	t7544	180
97	t5628	-149	218	-167	72	t3140	203	178	t8412	178
98	t5630	213	271	347	74	t3300	203	19	t380	177
99	t5660	220	26	-205	87	t4270	203	159	t8340	173
100	t5730	148	204	101	207	t8467	203	61	t2460	171
101	t5748	-93	89	319	52	t1600	203	124	t6810	163
102	t5870	-91	104	142	114	t6210	203	167	t8386	161
103	t5900	55	-33	253	240	t9220	203	3	t128	158
104	t5906	148	204	101	205	t8465	201	204	t8464	154
105	t5940	216	-18	-70	47	t1444	195	149	t8170	148

106	t5960	207	-50	-12		59	t2361	192		144	t8090	140	
107	t6010	248	276	285		157	t8300	190		150	t8178	139	
108	t6020	268	321	455		96	t5530	189		201	t8460	139	
109	t6030	-165	38	190		122	t6768	186		120	t6741	139	
110	t6060	-23	206	-34		119	t6740	184		252	t9538	139	
111	t6090	91	-37	133		247	t9380	184		51	t1550	138	
112	t6118	-80	212	-123		11	t162	183		241	t9288	138	
113	t6120	-147	58	217		160	t8352	182		205	t8465	130	
114	t6210	203	-51	164		249	t9428	178		41	t1138	128	
115	t6312	-103	1	48		46	t1440	176		185	t8430	128	
116	t6400	156	-56	186		60	t2430	176		222	t8728	128	
117	t6650	148	204	101		65	t2681	174		29	t773	126	
118	t6680	-94	253	-303		130	t7510	171		213	t8488	124	
119	t6740	184	217	110		219	t8610	170		85	t4230	123	
120	t6741	-84	139	-11		10	t161	164		145	t8108	117	
121	t6743	55	-33	253		208	t8470	162		181	t8416	114	
122	t6768	186	204	243		116	t6400	156		67	t2840	104	
123	t6801	78	8	85		24	t550	154		102	t5870	104	
124	t6810	223	163	4		13	t171	151		180	t8415	102	
125	t6851	55	-33	253		104	t5906	148		244	t9340	101	
126	t6890	330	-171	31		100	t5730	148		248	t9390	97	
127	t6894	369	459	41		117	t6650	148		94	t5380	95	
128	t6904	222	-67	-44		15	t198	145		101	t5748	89	
129	t7499	-37	238	-315		56	t2160	142		6	t138	89	
130	t7510	171	199	171		236	t8994	142		7	t151	85	
131	t7540	287	344	514		61	t2460	137		12	t164	85	
132	t7544	-148	180	-104		138	t8010	136		189	t8438	83	
133	t7560	321	238	-47		53	t1653	121		65	t2681	81	
134	t7610	294	-174	16		168	t8387	119		198	t8456	76	
135	t7768	221	244	299		223	t8730	117		22	t520	76	
136	t7790	-66	69	126		63	t2628	116		216	t8520	76	
137	t8008	-219	207	-115		3	t128	115		237	t8999	74	
138	t8010	136	193	98		18	t308	113		250	t9430	74	
139	t8040	207	305	225		253	t9908	105		136	t7790	69	
140	t8050	-94	253	-303		40	t1115	104		47	t1444	64	
141	t8057	328	402	330		29	t773	100		190	t8440	58	
142	t8060	337	304	-24		161	t8354	96		113	t6120	58	
143	t8080	55	-33	253		14	t189	96		245	t9358	56	
144	t8090	-28	140	333		90	t5090	93		226	t8978	56	
145	t8108	82	117	323		6	t138	92		186	t8435	52	
146	t8110	291	282	369		111	t6090	91		197	t8454	51	

147	t8120	-189	34	11	178	t8412	86	148	t8130	50
148	t8130	-85	50	196	238	t9025	84	153	t8219	49
149	t8170	23	148	135	173	t8404	83	86	t4248	44
150	t8178	-84	139	-11	145	t8108	82	38	t1070	38
151	t8180	55	-33	253	175	t8406	79	177	t8411	38
152	t8208	205	251	195	123	t6801	78	109	t6030	38
153	t8219	-144	49	158	167	t8386	69	155	t8298	35
154	t8239	16	-3	85	170	t8392	65	147	t8120	34
155	t8298	22	35	-172	191	t8441	63	227	t8979	33
156	t8299	-22	-50	149	125	t6851	55	238	t9025	31
157	t8300	190	232	193	71	t3071	55	30	t781	28
158	t8315	-90	252	-304	151	t8180	55	99	t5660	26
159	t8340	246	173	185	103	t5900	55	56	t2160	24
160	t8352	182	256	191	218	t8560	55	239	t9118	22
161	t8354	96	264	-66	143	t8080	55	14	t189	22
162	t8356	341	-104	185	121	t6743	55	191	t8441	20
163	t8358	6	-27	134	41	t1138	44	24	t550	19
164	t8382	269	-147	12	185	t8430	44	84	t4203	13
165	t8383	-61	234	-221	222	t8728	44	49	t1498	10
166	t8385	345	-126	231	68	t2901	43	69	t2925	9
167	t8386	69	161	-16	204	t8464	42	172	t8402	8
168	t8387	119	220	219	186	t8435	39	123	t6801	8
169	t8390	225	198	-6	187	t8436	25	53	t1653	5
170	t8392	65	-20	185	149	t8170	23	115	t6312	1
171	t8401	279	326	92	155	t8298	22	9	t155	0
172	t8402	-97	8	174	16	t258	20	200	t8459	-2
173	t8404	83	237	-135	154	t8239	16	154	t8239	-3
174	t8405	274	207	-114	180	t8415	11	175	t8406	-5
175	t8406	79	-5	272	163	t8358	6	236	t8994	-8
176	t8410	287	344	514	246	t9370	0	72	t3140	-9
177	t8411	-165	38	190	241	t9288	-4	74	t3300	-9
178	t8412	86	178	188	57	t2190	-8	39	t1094	-9
179	t8413	-9	-29	214	179	t8413	-9	240	t9220	-9
180	t8415	11	102	94	181	t8416	-15	52	t1600	-9
181	t8416	-15	114	352	233	t8989	-15	87	t4270	-9
182	t8419	369	459	41	66	t2730	-22	60	t2430	-14
183	t8421	-37	223	-153	83	t4202	-22	15	t198	-15
184	t8427	-66	246	-309	156	t8299	-22	21	t511	-16
185	t8430	44	128	-235	79	t3680	-22	242	t9290	-16
186	t8435	39	52	186	39	t1094	-22	246	t9370	-17
187	t8436	25	-30	127	26	t651	-22	105	t5940	-18

188	t8437	237	-63	120		67	t2840	-23		253	t9908	-18
189	t8438	-25	83	186		110	t6060	-23		170	t8392	-20
190	t8440	-74	58	190		19	t380	-24		57	t2190	-21
191	t8441	63	20	-25		189	t8438	-25		194	t8446	-23
192	t8443	217	292	274		144	t8090	-28		212	t8487	-23
193	t8444	356	351	199		242	t9290	-28		1	t8	-24
194	t8446	-93	-23	188		228	t8981	-29		18	t308	-25
195	t8450	323	228	213		232	t8987	-34		163	t8358	-27
196	t8453	246	-94	-13		129	t7499	-37		34	t1020	-27
197	t8454	-130	51	181		32	t1011	-37		8	t153	-29
198	t8456	-237	76	207		225	t8798	-37		179	t8413	-29
199	t8457	298	263	289		183	t8421	-37		187	t8436	-30
200	t8459	-115	-2	75		237	t8999	-39		4	t130	-31
201	t8460	-84	139	-11		212	t8487	-39		121	t6743	-33
202	t8461	337	-85	-6		248	t9390	-41		103	t5900	-33
203	t8462	275	267	282		30	t781	-42		151	t8180	-33
204	t8464	42	154	272		84	t4203	-53		71	t3071	-33
205	t8465	201	130	71		9	t155	-55		218	t8560	-33
206	t8466	237	-48	-22		239	t9118	-58		143	t8080	-33
207	t8467	203	-53	170		226	t8978	-58		125	t6851	-33
208	t8470	162	261	197		165	t8383	-61		16	t258	-35
209	t8471	-140	-38	168		136	t7790	-66		215	t8493	-36
210	t8472	293	-180	168		184	t8427	-66		232	t8987	-36
211	t8482	311	201	210		190	t8440	-74		111	t6090	-37
212	t8487	-39	-23	203		48	t1445	-75		209	t8471	-38
213	t8488	249	124	207		8	t153	-76		68	t2901	-40
214	t8490	293	334	269		7	t151	-78		91	t5130	-42
215	t8493	231	-36	137		245	t9358	-79		233	t8989	-45
216	t8520	-237	76	207		86	t4248	-79		254	t9950	-45
217	t8530	207	305	225		112	t6118	-80		206	t8466	-48
218	t8560	55	-33	253		150	t8178	-84		247	t9380	-49
219	t8610	170	227	214		201	t8460	-84		83	t4202	-50
220	t8630	238	-70	-66		120	t6741	-84		79	t3680	-50
221	t8708	219	279	202		252	t9538	-84		66	t2730	-50
222	t8728	44	128	-235		148	t8130	-85		156	t8299	-50
223	t8730	117	213	-292		158	t8315	-90		106	t5960	-50
224	t8734	291	266	-34		102	t5870	-91		114	t6210	-51
225	t8798	-37	238	-315		101	t5748	-93		89	t5030	-53
226	t8978	-58	56	99		194	t8446	-93		207	t8467	-53
227	t8979	-103	33	231		31	t1010	-94		62	t2491	-53
228	t8981	-29	209	223		118	t6680	-94		13	t171	-53

229	t8982	301	322	174		140	t8050	-94	116	t6400	-56
230	t8984	220	214	279		85	t4230	-97	188	t8437	-63
231	t8986	248	216	-19		172	t8402	-97	128	t6904	-67
232	t8987	-34	-36	69		12	t164	-101	77	t3590	-68
233	t8989	-15	-45	179		115	t6312	-103	220	t8630	-70
234	t8990	208	207	192		227	t8979	-103	70	t3020	-78
235	t8993	264	-151	200		1	t8	-112	251	t9450	-79
236	t8994	142	-8	150		200	t8459	-115	202	t8461	-85
237	t8999	-39	74	93		244	t9340	-117	249	t9428	-86
238	t9025	84	31	188		197	t8454	-130	196	t8453	-94
239	t9118	-58	22	162		209	t8471	-140	95	t5510	-96
240	t9220	203	-9	-43		153	t8219	-144	162	t8356	-104
241	t9288	-4	138	344		113	t6120	-147	166	t8385	-126
242	t9290	-28	-16	5		132	t7544	-148	35	t1030	-145
243	t9310	328	402	330		97	t5628	-149	164	t8382	-147
244	t9340	-117	101	141		109	t6030	-165	28	t757	-151
245	t9358	-79	56	183		177	t8411	-165	235	t8993	-151
246	t9370	0	-17	73		38	t1070	-165	5	t134	-169
247	t9380	184	-49	14		49	t1498	-167	126	t6890	-171
248	t9390	-41	97	-48		69	t2925	-175	134	t7610	-174
249	t9428	178	-86	192		147	t8120	-189	20	t410	-180
250	t9430	291	74	-17		4	t130	-199	210	t8472	-180
251	t9450	239	-79	-77		137	t8008	-219	93	t5360	-232
252	t9538	-84	139	-11		198	t8456	-237	2	t108	-269
253	t9908	105	-18	130		216	t8520	-237	42	t1180	-269
254	t9950	249	-45	-141		22	t520	-237	23	t540	-269

Spring 2007(Riffle/Pool at NFSR #1 and Glide/Pool at other NFSR Stations)

SAMPLE SCORES - WHICH ARE WEIGHTED MEAN SPECIES SCORES

N	NAME	AX1	AX2	AX3		RANKED 1 EIG=0.339			RANKED 2 EIG=0.195		
1	HC1_00	170	64	53		3	CC1_04	218	7	HC1_95	188
2	CC1_01	128	77	62		7	HC1_95	216	24	LD2_98	160
3	CC1_04	218	0	51		8	HC2_95	211	23	LD2_95	155
4	HC1_07	86	65	121		22	LD1_95	190	8	HC2_95	154
5	CC1_07	62	71	81		1	HC1_00	170	25	LD3_98	154

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   6 NF1_RP     143   28   53      |    23 LD2_95    167 |    11 LD1_01    153 |
   7 HC1_95     216  188   68      |     6 NF1_RP    143 |    10 LD2_01    150 |
   8 HC2_95     211  154   72      |    24 LD2_98    137 |    22 LD1_95    145 |
   9 LD1_00      68  113  136      |     2 CC1_01    128 |    18 LD1_07    119 |
  10 LD2_01      69  150    0      |    25 LD3_98    107 |     9 LD1_00    113 |
  11 LD1_01      56  153   14      |    20 NF3_GP     87 |    16 NF9b_GP   112 |
  12 NF10_GP     34   92   77      |     4 HC1_07     86 |    20 NF3_GP    103 |
  13 NF5_GP       0   45  124      |    14 NF6_GP     76 |    21 NF2_GP    100 |
  14 NF6_GP      76   95   49      |    10 LD2_01     69 |    14 NF6_GP     95 |
  15 NF9a_GP     38   92   94      |     9 LD1_00     68 |    19 NF7_GP     94 |
  16 NF9b_GP     50  112   80      |     5 CC1_07     62 |    12 NF10_GP    92 |
  17 NF8_GP      14   88  103      |    11 LD1_01     56 |    15 NF9a_GP    92 |
  18 LD1_07      12  119   46      |    21 NF2_GP     50 |    17 NF8_GP     88 |
  19 NF7_GP      48   94  103      |    16 NF9b_GP    50 |     2 CC1_01     77 |
  20 NF3_GP      87  103   47      |    19 NF7_GP     48 |     5 CC1_07     71 |
  21 NF2_GP      50  100   75      |    15 NF9a_GP    38 |     4 HC1_07     65 |
  22 LD1_95     190  145  133      |    12 NF10_GP    34 |     1 HC1_00     64 |
  23 LD2_95     167  155  159      |    17 NF8_GP     14 |    13 NF5_GP     45 |
  24 LD2_98     137  160  113      |    18 LD1_07     12 |     6 NF1_RP     28 |
  25 LD3_98     107  154   86      |    13 NF5_GP      0 |     3 CC1_04      0 |

************************** Calculations finished **************************
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Appendix D

Dissolved Oxygen and Water Temperature Datalogger Data Colleced at NFSR #1, NFSR #3, NFSR #6, NFSR #9, and Horse Creek #1 During the Summer of 2006

AQUA 2002 Data Report
****
Start time [Day] : 8/07/2006 09:00
Down load time [Day] : 8/10/2006 19:48
Sample interval [Minute(s)] : 00:15
Battery status at down load : OK
Samples collected : 332
****

Notes:
****
Logger #107
PP# 100465
Sampling Station: NFSR #1
****

Date/Time	Water Temperature	Dissolved Oxygen
8/7/2006 11:30	28.8	5.03
8/7/2006 11:45	28.96	4.27
8/7/2006 12:00	29.88	4.85
8/7/2006 12:15	29.73	4.45
8/7/2006 12:30	30.09	4.5
8/7/2006 12:45	30.38	4.6
8/7/2006 13:00	30.53	4.69
8/7/2006 13:15	30.94	4.99
8/7/2006 13:30	31.1	4.88
8/7/2006 13:45	31.39	5.1
8/7/2006 14:00	31.53	5.41
8/7/2006 14:15	31.81	5.61
8/7/2006 14:30	31.9	5.82
8/7/2006 14:45	32	5.88
8/7/2006 15:00	32.07	5.82
8/7/2006 15:15	32.15	6.32
8/7/2006 15:30	32.25	6.08
8/7/2006 15:45	32.28	6.25
8/7/2006 16:00	32.25	6.09
8/7/2006 16:15	32.24	5.93
8/7/2006 16:30	32.17	6.06
8/7/2006 16:45	32.25	5.86
8/7/2006 17:00	32.19	5.79
8/7/2006 17:15	32.2	5.54
8/7/2006 17:30	32.07	5.67
8/7/2006 17:45	32.01	5.43
8/7/2006 18:00	31.94	5.66
8/7/2006 18:15	31.86	5.59
8/7/2006 18:30	31.77	5.72
8/7/2006 18:45	31.65	5.47
8/7/2006 19:00	31.53	5.66
8/7/2006 19:15	31.41	5.69
8/7/2006 19:30	31.26	5.42

8/7/2006 19:45	31.22	5.07
8/7/2006 20:00	31.09	4.95
8/7/2006 20:15	30.96	5.14
8/7/2006 20:30	30.84	5.12
8/7/2006 20:45	30.71	5.06
8/7/2006 21:00	30.59	4.98
8/7/2006 21:15	30.48	4.84
8/7/2006 21:30	30.32	4.51
8/7/2006 21:45	30.19	4.42
8/7/2006 22:00	30.08	4.19
8/7/2006 22:15	30	4.41
8/7/2006 22:30	29.9	4.12
8/7/2006 22:45	29.78	4.14
8/7/2006 23:00	29.74	4.11
8/7/2006 23:15	29.65	4.06
8/7/2006 23:30	29.55	4.01
8/7/2006 23:45	29.47	3.97
8/8/2006 0:00	29.38	3.88
8/8/2006 0:15	29.29	3.48
8/8/2006 0:30	29.19	3.78
8/8/2006 0:45	29.1	3.72
8/8/2006 1:00	29.04	3.64
8/8/2006 1:15	28.92	3.58
8/8/2006 1:30	28.93	3.59
8/8/2006 1:45	28.82	3.49
8/8/2006 2:00	28.74	3.4
8/8/2006 2:15	28.65	3.24
8/8/2006 2:30	28.58	3.3
8/8/2006 2:45	28.48	3.24
8/8/2006 3:00	28.37	3.21
8/8/2006 3:15	28.34	3.07
8/8/2006 3:30	28.28	3.03
8/8/2006 3:45	28.15	3.03
8/8/2006 4:00	28.06	3.02
8/8/2006 4:15	27.98	3.01
8/8/2006 4:30	27.94	2.96
8/8/2006 4:45	27.8	2.97
8/8/2006 5:00	27.75	2.84
8/8/2006 5:15	27.62	2.84
8/8/2006 5:30	27.58	2.77
8/8/2006 5:45	27.44	2.66
8/8/2006 6:00	27.4	2.55
8/8/2006 6:15	27.35	2.61
8/8/2006 6:30	27.27	2.67
8/8/2006 6:45	27.13	2.49
8/8/2006 7:00	27.11	2.57
8/8/2006 7:15	27.05	2.44
8/8/2006 7:30	26.99	2.52
8/8/2006 7:45	26.98	2.51
8/8/2006 8:00	26.94	2.57

8/8/2006 8:15	26.95	2.55
8/8/2006 8:30	26.87	2.53
8/8/2006 8:45	26.89	2.52
8/8/2006 9:00	26.94	2.54
8/8/2006 9:15	27.02	2.65
8/8/2006 9:30	27.12	2.74
8/8/2006 9:45	27.2	2.94
8/8/2006 10:00	27.39	3.04
8/8/2006 10:15	27.56	3.46
8/8/2006 10:30	27.74	3.8
8/8/2006 10:45	27.91	3.89
8/8/2006 11:00	28.16	4.21
8/8/2006 11:15	28.31	4.36
8/8/2006 11:30	28.54	4.54
8/8/2006 11:45	28.77	4.85
8/8/2006 12:00	28.89	4.69
8/8/2006 12:15	29.12	4.56
8/8/2006 12:30	29.32	4.98
8/8/2006 12:45	29.56	5.23
8/8/2006 13:00	29.81	5.41
8/8/2006 13:15	30.04	5.78
8/8/2006 13:30	30.22	6.13
8/8/2006 13:45	30.38	6.32
8/8/2006 14:00	30.66	6.49
8/8/2006 14:15	30.81	6.48
8/8/2006 14:30	31	6.13
8/8/2006 14:45	31.21	5.98
8/8/2006 15:00	31.29	6.52
8/8/2006 15:15	31.36	7.03
8/8/2006 15:30	31.55	6.69
8/8/2006 15:45	31.44	6.55
8/8/2006 16:00	31.47	6.72
8/8/2006 16:15	31.55	6.71
8/8/2006 16:30	31.67	6.51
8/8/2006 16:45	31.65	6.43
8/8/2006 17:00	31.51	4.48
8/8/2006 17:15	31.38	5.92
8/8/2006 17:30	31.45	5.87
8/8/2006 17:45	31.46	5.25
8/8/2006 18:00	31.39	5.64
8/8/2006 18:15	31.32	5.46
8/8/2006 18:30	31.26	5.53
8/8/2006 18:45	31.2	4.05
8/8/2006 19:00	31.1	4.32
8/8/2006 19:15	31	4.25
8/8/2006 19:30	30.88	4.89
8/8/2006 19:45	30.76	5.11
8/8/2006 20:00	30.74	4.93
8/8/2006 20:15	30.67	4.85
8/8/2006 20:30	30.58	4.84

8/8/2006 20:45	30.55	4.76
8/8/2006 21:00	30.41	4.75
8/8/2006 21:15	30.33	4.42
8/8/2006 21:30	30.23	4.42
8/8/2006 21:45	30.15	4.29
8/8/2006 22:00	30.07	4.07
8/8/2006 22:15	29.98	4.08
8/8/2006 22:30	29.86	3.97
8/8/2006 22:45	29.78	4.02
8/8/2006 23:00	29.68	4.01
8/8/2006 23:15	29.61	3.89
8/8/2006 23:30	29.55	3.82
8/8/2006 23:45	29.47	3.61
8/9/2006 0:00	29.35	3.67
8/9/2006 0:15	29.23	3.49
8/9/2006 0:30	29.18	3.47
8/9/2006 0:45	29.11	3.29
8/9/2006 1:00	29.01	3.32
8/9/2006 1:15	28.94	3.06
8/9/2006 1:30	28.88	3.04
8/9/2006 1:45	28.77	3.05
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8/9/2006 2:15	28.69	2.81
8/9/2006 2:30	28.58	2.85
8/9/2006 2:45	28.52	2.81
8/9/2006 3:00	28.44	2.84
8/9/2006 3:15	28.4	2.77
8/9/2006 3:30	28.34	2.6
8/9/2006 3:45	28.26	2.6
8/9/2006 4:00	28.2	2.65
8/9/2006 4:15	28.13	2.55
8/9/2006 4:30	28.1	2.5
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8/9/2006 5:00	27.98	2.34
8/9/2006 5:15	27.94	2.29
8/9/2006 5:30	27.89	2.28
8/9/2006 5:45	27.84	2.2
8/9/2006 6:00	27.81	2.17
8/9/2006 6:15	27.72	2.09
8/9/2006 6:30	27.67	2.05
8/9/2006 6:45	27.6	2
8/9/2006 7:00	27.54	1.98
8/9/2006 7:15	27.51	1.93
8/9/2006 7:30	27.5	1.91
8/9/2006 7:45	27.47	1.91
8/9/2006 8:00	27.45	1.91
8/9/2006 8:15	27.44	1.86
8/9/2006 8:30	27.45	1.86
8/9/2006 8:45	27.44	1.84
8/9/2006 9:00	27.41	1.92

8/9/2006 9:15	27.41	1.94
8/9/2006 9:30	27.43	2.1
8/9/2006 9:45	27.48	2.19
8/9/2006 10:00	27.61	2.29
8/9/2006 10:15	27.8	2.49
8/9/2006 10:30	28.02	2.94
8/9/2006 10:45	28.15	3.18
8/9/2006 11:00	28.15	3.07
8/9/2006 11:15	28.32	3.24
8/9/2006 11:30	28.42	3.15
8/9/2006 11:45	28.62	3.39
8/9/2006 12:00	28.78	3.4
8/9/2006 12:15	28.83	3.64
8/9/2006 12:30	28.88	3.57
8/9/2006 12:45	29.06	3.68
8/9/2006 13:00	29.02	3.77
8/9/2006 13:15	29.15	3.87
8/9/2006 13:30	29.46	3.98
8/9/2006 13:45	29.52	4.18
8/9/2006 14:00	29.93	4.27
8/9/2006 14:15	30.07	4.6
8/9/2006 14:30	30.33	4.8
8/9/2006 14:45	30.5	5.04
8/9/2006 15:00	30.62	5.16
8/9/2006 15:15	30.7	5.06
8/9/2006 15:30	30.71	5.24
8/9/2006 15:45	30.81	5.16
8/9/2006 16:00	30.87	4.86
8/9/2006 16:15	30.83	5.17
8/9/2006 16:30	30.98	5.33
8/9/2006 16:45	30.89	5.21
8/9/2006 17:00	30.8	4.95
8/9/2006 17:15	30.95	4.84
8/9/2006 17:30	30.9	4.74
8/9/2006 17:45	30.95	4.81
8/9/2006 18:00	30.96	4.65
8/9/2006 18:15	30.96	4.56
8/9/2006 18:30	30.86	4.48
8/9/2006 18:45	30.74	4.67
8/9/2006 19:00	30.64	4.67
8/9/2006 19:15	30.52	4.5
8/9/2006 19:30	30.41	3.69
8/9/2006 19:45	30.3	3.21
8/9/2006 20:00	30.19	3.16
8/9/2006 20:15	30.11	3.22
8/9/2006 20:30	30.03	3.27
8/9/2006 20:45	29.94	3.46
8/9/2006 21:00	29.83	3.71
8/9/2006 21:15	29.8	3.73
8/9/2006 21:30	29.72	3.73

8/9/2006 21:45	29.63	3.65
8/9/2006 22:00	29.56	3.7
8/9/2006 22:15	29.51	3.74
8/9/2006 22:30	29.45	3.53
8/9/2006 22:45	29.42	3.34
8/9/2006 23:00	29.33	3.41
8/9/2006 23:15	29.29	3.39
8/9/2006 23:30	29.27	3.28
8/9/2006 23:45	29.22	3.06
8/10/2006 0:00	29.19	2.89
8/10/2006 0:15	29.12	2.9
8/10/2006 0:30	29.08	2.93
8/10/2006 0:45	29.05	2.77
8/10/2006 1:00	28.98	2.47
8/10/2006 1:15	28.93	2.62
8/10/2006 1:30	28.9	2.57
8/10/2006 1:45	28.85	2.55
8/10/2006 2:00	28.82	2.54
8/10/2006 2:15	28.77	2.23
8/10/2006 2:30	28.74	2.32
8/10/2006 2:45	28.71	2.27
8/10/2006 3:00	28.64	2.28
8/10/2006 3:15	28.59	2.2
8/10/2006 3:30	28.53	2.23
8/10/2006 3:45	28.48	2.18
8/10/2006 4:00	28.44	2.14
8/10/2006 4:15	28.4	2.12
8/10/2006 4:30	28.36	2.03
8/10/2006 4:45	28.3	1.98
8/10/2006 5:00	28.25	1.9
8/10/2006 5:15	28.23	1.93
8/10/2006 5:30	28.18	1.9
8/10/2006 5:45	28.11	1.85
8/10/2006 6:00	28.04	1.77
8/10/2006 6:15	28.01	1.75
8/10/2006 6:30	27.92	1.75
8/10/2006 6:45	27.61	2.44
8/10/2006 7:00	27.57	2.89
8/10/2006 7:15	27.57	2.64
8/10/2006 7:30	27.59	2.39
8/10/2006 7:45	27.53	2.25
8/10/2006 8:00	27.52	2.18
8/10/2006 8:15	27.49	2.08
8/10/2006 8:30	27.45	2
8/10/2006 8:45	27.34	1.95
8/10/2006 9:00	27.32	1.91
8/10/2006 9:15	27.31	1.94
8/10/2006 9:30	27.26	1.92
8/10/2006 9:45	27.28	2.02
8/10/2006 10:00	27.27	2

8/10/2006 10:15	27.23	1.96
8/10/2006 10:30	27.22	1.95
8/10/2006 10:45	27.25	2.07
8/10/2006 11:00	27.26	2.13
8/10/2006 11:15	27.27	2.23
8/10/2006 11:30	27.32	2.36
8/10/2006 11:45	27.39	2.64
8/10/2006 12:00	27.45	2.84
8/10/2006 12:15	27.54	3.13
8/10/2006 12:30	27.72	3.23
8/10/2006 12:45	28.03	3.13
8/10/2006 13:00	28.02	3
8/10/2006 13:15	28.16	3.22
8/10/2006 13:30	28.11	3.27

AQUA 2002 Data Report
****
Start time [Day] : 8/07/2006 09:00
Down load time [Day] : 8/10/2006 19:45
Sample interval [Minute(s)] : 00:15
Battery status at down load : OK
Samples collected : 332
****

Notes:
****
Unit # 109
PP# 10046
Sampling Station: NFSR #3
****

Date/Time	Water Temperature	Dissolved Oxygen
8/7/2006 13:00	28.5	2.02
8/7/2006 13:15	28.41	1.54
8/7/2006 13:30	28.44	1.51
8/7/2006 13:45	28.47	1.45
8/7/2006 14:00	28.51	1.33
8/7/2006 14:15	28.53	1.15
8/7/2006 14:30	28.59	1.17
8/7/2006 14:45	28.64	1.19
8/7/2006 15:00	28.68	1.2
8/7/2006 15:15	28.76	1.14
8/7/2006 15:30	28.78	1.14
8/7/2006 15:45	28.85	1.2
8/7/2006 16:00	28.87	1.26
8/7/2006 16:15	28.93	1.11
8/7/2006 16:30	29.02	1.39
8/7/2006 16:45	28.97	1.28
8/7/2006 17:00	29.04	1.02
8/7/2006 17:15	29.06	1.19
8/7/2006 17:30	29.4	1.25
8/7/2006 17:45	29.48	1.39
8/7/2006 18:00	29.52	1.36
8/7/2006 18:15	29.53	1.5
8/7/2006 18:30	29.7	1.68
8/7/2006 18:45	29.63	1.41
8/7/2006 19:00	29.79	1.77
8/7/2006 19:15	29.79	1.42
8/7/2006 19:30	29.76	1.53
8/7/2006 19:45	29.72	1.28
8/7/2006 20:00	29.75	1.24
8/7/2006 20:15	29.76	1.53
8/7/2006 20:30	29.84	1.97
8/7/2006 20:45	29.81	1.74
8/7/2006 21:00	29.87	2.05

8/7/2006 21:15	29.9	3.57
8/7/2006 21:30	29.85	3.44
8/7/2006 21:45	29.75	3.39
8/7/2006 22:00	29.65	3.48
8/7/2006 22:15	29.54	3.21
8/7/2006 22:30	29.44	3.36
8/7/2006 22:45	29.35	3.26
8/7/2006 23:00	29.26	3.08
8/7/2006 23:15	29.18	3.23
8/7/2006 23:30	29.12	3.02
8/7/2006 23:45	29.06	2.66
8/8/2006 0:00	28.98	2.85
8/8/2006 0:15	28.94	2.63
8/8/2006 0:30	28.88	2.67
8/8/2006 0:45	28.82	2.86
8/8/2006 1:00	28.76	2.53
8/8/2006 1:15	28.7	2.37
8/8/2006 1:30	28.65	2.52
8/8/2006 1:45	28.57	2.36
8/8/2006 2:00	28.52	2.32
8/8/2006 2:15	28.47	2.19
8/8/2006 2:30	28.42	2.46
8/8/2006 2:45	28.37	2.26
8/8/2006 3:00	28.32	2.03
8/8/2006 3:15	28.26	2.43
8/8/2006 3:30	28.19	2.11
8/8/2006 3:45	28.11	2.34
8/8/2006 4:00	28.05	2.24
8/8/2006 4:15	27.98	2.4
8/8/2006 4:30	27.91	1.99
8/8/2006 4:45	27.85	1.98
8/8/2006 5:00	27.81	2.03
8/8/2006 5:15	27.75	1.91
8/8/2006 5:30	27.69	2.03
8/8/2006 5:45	27.62	1.94
8/8/2006 6:00	27.57	1.96
8/8/2006 6:15	27.52	1.89
8/8/2006 6:30	27.45	1.92
8/8/2006 6:45	27.41	2.09
8/8/2006 7:00	27.35	2.33
8/8/2006 7:15	27.31	1.82
8/8/2006 7:30	27.25	2.13
8/8/2006 7:45	27.23	1.75
8/8/2006 8:00	27.19	1.72
8/8/2006 8:15	27.17	1.62
8/8/2006 8:30	27.16	1.64
8/8/2006 8:45	27.17	1.64
8/8/2006 9:00	27.17	1.35
8/8/2006 9:15	27.18	1.42
8/8/2006 9:30	27.16	1.27

8/8/2006 9:45	27.18	1.21
8/8/2006 10:00	27.18	1.16
8/8/2006 10:15	27.19	1.1
8/8/2006 10:30	27.21	1.16
8/8/2006 10:45	27.26	1.43
8/8/2006 11:00	27.26	1.01
8/8/2006 11:15	27.28	1.1
8/8/2006 11:30	27.29	0.96
8/8/2006 11:45	27.3	0.89
8/8/2006 12:00	27.32	0.94
8/8/2006 12:15	27.34	1.06
8/8/2006 12:30	27.39	0.89
8/8/2006 12:45	27.41	0.73
8/8/2006 13:00	27.44	0.91
8/8/2006 13:15	27.48	0.68
8/8/2006 13:30	27.53	0.9
8/8/2006 13:45	27.58	0.68
8/8/2006 14:00	27.63	0.65
8/8/2006 14:15	27.67	1.05
8/8/2006 14:30	27.77	1.02
8/8/2006 14:45	27.86	1.07
8/8/2006 15:00	27.96	1
8/8/2006 15:15	28.06	1.24
8/8/2006 15:30	28.12	1
8/8/2006 15:45	28.13	1.17
8/8/2006 16:00	28.24	1.23
8/8/2006 16:15	28.27	1.35
8/8/2006 16:30	28.3	1.13
8/8/2006 16:45	28.36	0.87
8/8/2006 17:00	28.39	1.01
8/8/2006 17:15	28.46	1.1
8/8/2006 17:30	28.47	0.89
8/8/2006 17:45	28.53	0.96
8/8/2006 18:00	28.65	1.18
8/8/2006 18:15	28.68	0.92
8/8/2006 18:30	28.8	1.1
8/8/2006 18:45	28.83	0.92
8/8/2006 19:00	28.87	0.92
8/8/2006 19:15	28.9	0.9
8/8/2006 19:30	28.94	0.78
8/8/2006 19:45	28.99	0.62
8/8/2006 20:00	28.97	1.06
8/8/2006 20:15	29	0.84
8/8/2006 20:30	28.99	0.66
8/8/2006 20:45	29.08	1.22
8/8/2006 21:00	29.03	0.89
8/8/2006 21:15	29.09	0.82
8/8/2006 21:30	29.25	2.11
8/8/2006 21:45	29.16	2.06
8/8/2006 22:00	29.14	2.81

8/8/2006 22:15	29.08	2.64
8/8/2006 22:30	29	2.62
8/8/2006 22:45	28.93	2.65
8/8/2006 23:00	28.85	2.59
8/8/2006 23:15	28.78	2.58
8/8/2006 23:30	28.72	2.51
8/8/2006 23:45	28.64	2.48
8/9/2006 0:00	28.58	2.16
8/9/2006 0:15	28.48	2.1
8/9/2006 0:30	28.45	2.03
8/9/2006 0:45	28.38	2.1
8/9/2006 1:00	28.33	2.43
8/9/2006 1:15	28.27	1.91
8/9/2006 1:30	28.22	1.9
8/9/2006 1:45	28.16	2.23
8/9/2006 2:00	28.11	1.98
8/9/2006 2:15	28.05	1.86
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8/9/2006 3:00	27.92	2
8/9/2006 3:15	27.87	1.92
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8/9/2006 4:45	27.67	1.75
8/9/2006 5:00	27.63	1.67
8/9/2006 5:15	27.58	1.68
8/9/2006 5:30	27.56	1.55
8/9/2006 5:45	27.53	1.64
8/9/2006 6:00	27.48	1.58
8/9/2006 6:15	27.45	1.61
8/9/2006 6:30	27.41	1.39
8/9/2006 6:45	27.38	1.39
8/9/2006 7:00	27.35	1.41
8/9/2006 7:15	27.32	1.41
8/9/2006 7:30	27.3	1.51
8/9/2006 7:45	27.27	1.4
8/9/2006 8:00	27.27	1.28
8/9/2006 8:15	27.26	1.31
8/9/2006 8:30	27.29	1.19
8/9/2006 8:45	27.3	1.15
8/9/2006 9:00	27.29	1.33
8/9/2006 9:15	27.3	1
8/9/2006 9:30	27.3	0.97
8/9/2006 9:45	27.33	1.01
8/9/2006 10:00	27.32	0.98
8/9/2006 10:15	27.36	1.71
8/9/2006 10:30	27.41	1.26

8/9/2006 10:45	27.4	1.22
8/9/2006 11:00	27.42	1.01
8/9/2006 11:15	27.45	0.98
8/9/2006 11:30	27.47	0.77
8/9/2006 11:45	27.49	0.98
8/9/2006 12:00	27.49	0.84
8/9/2006 12:15	27.5	0.8
8/9/2006 12:30	27.52	0.77
8/9/2006 12:45	27.54	0.64
8/9/2006 13:00	27.55	0.61
8/9/2006 13:15	27.57	0.67
8/9/2006 13:30	27.6	0.84
8/9/2006 13:45	27.68	0.72
8/9/2006 14:00	27.77	0.87
8/9/2006 14:15	27.9	0.91
8/9/2006 14:30	28.06	0.77
8/9/2006 14:45	28.13	0.96
8/9/2006 15:00	28.24	1.27
8/9/2006 15:15	28.32	0.91
8/9/2006 15:30	28.4	1.11
8/9/2006 15:45	28.46	1.04
8/9/2006 16:00	28.51	0.98
8/9/2006 16:15	28.5	1.1
8/9/2006 16:30	28.56	1.23
8/9/2006 16:45	28.61	0.94
8/9/2006 17:00	28.63	1
8/9/2006 17:15	28.61	1.02
8/9/2006 17:30	28.68	0.92
8/9/2006 17:45	28.68	0.9
8/9/2006 18:00	28.76	0.72
8/9/2006 18:15	28.77	0.86
8/9/2006 18:30	28.85	0.82
8/9/2006 18:45	28.91	0.68
8/9/2006 19:00	28.96	0.64
8/9/2006 19:15	28.98	0.94
8/9/2006 19:30	29.19	1.34
8/9/2006 19:45	29.17	1.45
8/9/2006 20:00	29.23	1.96
8/9/2006 20:15	29.24	1.74
8/9/2006 20:30	29.32	2.26
8/9/2006 20:45	29.27	2.7
8/9/2006 21:00	29.2	2.68
8/9/2006 21:15	29.12	2.64
8/9/2006 21:30	29.04	2.52
8/9/2006 21:45	28.96	2.5
8/9/2006 22:00	28.89	2.49
8/9/2006 22:15	28.83	2.28
8/9/2006 22:30	28.76	2.3
8/9/2006 22:45	28.71	2.16
8/9/2006 23:00	28.67	2.1

8/9/2006 23:15	28.63	2.09
8/9/2006 23:30	28.59	1.95
8/9/2006 23:45	28.53	1.86
8/10/2006 0:00	28.49	1.98
8/10/2006 0:15	28.44	1.97
8/10/2006 0:30	28.39	1.99
8/10/2006 0:45	28.34	1.84
8/10/2006 1:00	28.31	1.95
8/10/2006 1:15	28.26	1.77
8/10/2006 1:30	28.23	1.84
8/10/2006 1:45	28.2	1.76
8/10/2006 2:00	28.17	1.84
8/10/2006 2:15	28.14	1.76
8/10/2006 2:30	28.1	1.86
8/10/2006 2:45	28.05	1.83
8/10/2006 3:00	28.01	1.65
8/10/2006 3:15	27.95	1.6
8/10/2006 3:30	27.92	1.59
8/10/2006 3:45	27.88	1.43
8/10/2006 4:00	27.84	1.45
8/10/2006 4:15	27.8	1.38
8/10/2006 4:30	27.79	1.49
8/10/2006 4:45	27.77	1.34
8/10/2006 5:00	27.75	1.33
8/10/2006 5:15	27.73	1.33
8/10/2006 5:30	27.71	1.25
8/10/2006 5:45	27.68	1.16
8/10/2006 6:00	27.66	1.2
8/10/2006 6:15	27.62	1.15
8/10/2006 6:30	27.6	1.2
8/10/2006 6:45	27.57	1.19
8/10/2006 7:00	27.54	1.24
8/10/2006 7:15	27.5	0.93
8/10/2006 7:30	27.47	0.94
8/10/2006 7:45	27.41	1.27
8/10/2006 8:00	27.37	1.08
8/10/2006 8:15	27.34	0.83
8/10/2006 8:30	27.29	0.99
8/10/2006 8:45	27.27	1.16
8/10/2006 9:00	27.24	1.11
8/10/2006 9:15	27.22	1.05
8/10/2006 9:30	27.21	0.97
8/10/2006 9:45	27.21	0.92
8/10/2006 10:00	27.21	0.84
8/10/2006 10:15	27.2	0.95
8/10/2006 10:30	27.19	0.6
8/10/2006 10:45	27.18	0.77
8/10/2006 11:00	27.18	0.52
8/10/2006 11:15	27.18	0.6
8/10/2006 11:30	27.17	0.68

8/10/2006 11:45	27.19	0.58
8/10/2006 12:00	27.2	0.48
8/10/2006 12:15	27.23	0.49
8/10/2006 12:30	27.23	0.56
8/10/2006 12:45	27.24	0.55
8/10/2006 13:00	27.26	0.4
8/10/2006 13:15	27.28	0.43
8/10/2006 13:30	27.3	0.33
8/10/2006 13:45	27.33	0.39
8/10/2006 14:00	27.37	0.38
8/10/2006 14:15	27.43	0.49
8/10/2006 14:30	27.43	0.81
8/10/2006 14:45	27.77	1.41

AQUA 2002 Data Report
****
Start time [Day] : 7/31/2006 08:00
Down load time [Day] : 8/04/2006 07:27
Sample interval [Minute(s)] : 00:15
Battery status at down load : OK
Samples collected : 382
****

Notes:
****
Logger #107
PP# 100465
Sampling Station: NFSR #6
****

Date/Time	Water Temperature	Dissolved Oxygen
7/31/2006 11:00	26.6	3.6
7/31/2006 11:15	26.9	3.81
7/31/2006 11:30	26.96	3.54
7/31/2006 11:45	27.07	3.84
7/31/2006 12:00	27.36	4
7/31/2006 12:15	27.63	3.88
7/31/2006 12:30	27.85	4.16
7/31/2006 12:45	28.14	4.24
7/31/2006 13:00	28.54	4.4
7/31/2006 13:15	28.42	4.09
7/31/2006 13:30	29.21	4.21
7/31/2006 13:45	29.44	4.31
7/31/2006 14:00	29.77	4.17
7/31/2006 14:15	30.22	4.55
7/31/2006 14:30	30.01	4.22
7/31/2006 14:45	29.83	3.8
7/31/2006 15:00	30.61	4.06
7/31/2006 15:15	30.77	4.09
7/31/2006 15:30	30.59	3.96
7/31/2006 15:45	30.21	3.96
7/31/2006 16:00	30.59	3.97
7/31/2006 16:15	30.62	3.84
7/31/2006 16:30	30.01	3.32
7/31/2006 16:45	30.23	3.63
7/31/2006 17:00	30.29	3.6
7/31/2006 17:15	30.25	3.65
7/31/2006 17:30	30.22	3.95
7/31/2006 17:45	30.16	4.25
7/31/2006 18:00	30.03	4.62
7/31/2006 18:15	29.95	4.1
7/31/2006 18:30	29.88	4.48
7/31/2006 18:45	29.64	3.91
7/31/2006 19:00	29.58	3.36

7/31/2006 19:15	29.55	3.67
7/31/2006 19:30	29.44	4.24
7/31/2006 19:45	29.06	3.46
7/31/2006 20:00	29.12	3.81
7/31/2006 20:15	29.09	4.29
7/31/2006 20:30	29.04	4.28
7/31/2006 20:45	28.97	4.16
7/31/2006 21:00	28.91	4.27
7/31/2006 21:15	28.84	4.31
7/31/2006 21:30	28.75	4.24
7/31/2006 21:45	28.66	4.01
7/31/2006 22:00	28.55	4.24
7/31/2006 22:15	28.48	4.25
7/31/2006 22:30	28.42	4.16
7/31/2006 22:45	28.35	4.26
7/31/2006 23:00	28.31	4.23
7/31/2006 23:15	28.26	4.09
7/31/2006 23:30	28.2	4.13
7/31/2006 23:45	28.14	4.09
8/1/2006 0:00	28.08	4.12
8/1/2006 0:15	27.98	3.6
8/1/2006 0:30	27.93	4.16
8/1/2006 0:45	27.87	4.24
8/1/2006 1:00	27.81	4.03
8/1/2006 1:15	27.75	4.24
8/1/2006 1:30	27.69	4.12
8/1/2006 1:45	27.61	4.04
8/1/2006 2:00	27.53	4.18
8/1/2006 2:15	27.44	3.49
8/1/2006 2:30	27.34	3.75
8/1/2006 2:45	27.25	3.8
8/1/2006 3:00	27.16	4.05
8/1/2006 3:15	27.15	3.75
8/1/2006 3:30	27.11	3.82
8/1/2006 3:45	27.06	3.69
8/1/2006 4:00	27	3.63
8/1/2006 4:15	26.95	3.54
8/1/2006 4:30	26.87	3.58
8/1/2006 4:45	26.82	3.64
8/1/2006 5:00	26.78	3.68
8/1/2006 5:15	26.74	3.51
8/1/2006 5:30	26.68	3.58
8/1/2006 5:45	26.65	3.5
8/1/2006 6:00	26.63	3.43
8/1/2006 6:15	26.6	3.56
8/1/2006 6:30	26.58	3.51
8/1/2006 6:45	26.56	3.56
8/1/2006 7:00	26.53	3.36
8/1/2006 7:15	26.51	3.55
8/1/2006 7:30	26.48	3.38

8/1/2006 7:45	26.47	3.44
8/1/2006 8:00	26.45	3.47
8/1/2006 8:15	26.45	3.25
8/1/2006 8:30	26.45	3.23
8/1/2006 8:45	26.47	3.22
8/1/2006 9:00	26.48	3.2
8/1/2006 9:15	26.5	3.16
8/1/2006 9:30	26.51	3.11
8/1/2006 9:45	26.54	3.1
8/1/2006 10:00	26.57	3.1
8/1/2006 10:15	26.58	3.13
8/1/2006 10:30	26.61	3.13
8/1/2006 10:45	26.68	3.09
8/1/2006 11:00	26.79	3.1
8/1/2006 11:15	26.99	3.16
8/1/2006 11:30	27.1	3.18
8/1/2006 11:45	27.21	3.28
8/1/2006 12:00	27.35	3.49
8/1/2006 12:15	27.52	3.8
8/1/2006 12:30	27.78	4.07
8/1/2006 12:45	28.23	4.19
8/1/2006 13:00	28.59	4.2
8/1/2006 13:15	29.04	4.17
8/1/2006 13:30	29.44	4.26
8/1/2006 13:45	29.68	4.37
8/1/2006 14:00	29.5	4.2
8/1/2006 14:15	30.13	4.55
8/1/2006 14:30	30.41	4.63
8/1/2006 14:45	30.74	4.64
8/1/2006 15:00	30.73	4.5
8/1/2006 15:15	30.57	4.24
8/1/2006 15:30	30.72	4
8/1/2006 15:45	30.64	3.77
8/1/2006 16:00	30.71	3.98
8/1/2006 16:15	30.74	3.96
8/1/2006 16:30	30.43	3.81
8/1/2006 16:45	30.67	4.19
8/1/2006 17:00	30.54	4.14
8/1/2006 17:15	30.42	4.28
8/1/2006 17:30	30.27	3.89
8/1/2006 17:45	30.24	4.28
8/1/2006 18:00	30.17	4.23
8/1/2006 18:15	30.09	4.29
8/1/2006 18:30	30	4.34
8/1/2006 18:45	29.9	4.3
8/1/2006 19:00	29.78	4.11
8/1/2006 19:15	29.69	4.21
8/1/2006 19:30	29.51	4.18
8/1/2006 19:45	29.46	4.13
8/1/2006 20:00	29.38	4.21

8/1/2006 20:15	29.27	4.18
8/1/2006 20:30	29.19	4.21
8/1/2006 20:45	29.11	4.28
8/1/2006 21:00	29.03	4.24
8/1/2006 21:15	28.94	4.1
8/1/2006 21:30	28.87	4.21
8/1/2006 21:45	28.79	4.31
8/1/2006 22:00	28.72	4.2
8/1/2006 22:15	28.65	4.23
8/1/2006 22:30	28.55	4.21
8/1/2006 22:45	28.48	4.21
8/1/2006 23:00	28.42	3.86
8/1/2006 23:15	28.32	3.79
8/1/2006 23:30	28.26	3.8
8/1/2006 23:45	28.14	3.92
8/2/2006 0:00	28.07	4.07
8/2/2006 0:15	28.01	4.05
8/2/2006 0:30	27.92	4.29
8/2/2006 0:45	27.89	4.09
8/2/2006 1:00	27.8	4.4
8/2/2006 1:15	27.73	4.28
8/2/2006 1:30	27.65	4.21
8/2/2006 1:45	27.59	4.39
8/2/2006 2:00	27.53	4.19
8/2/2006 2:15	27.46	4.33
8/2/2006 2:30	27.4	4.19
8/2/2006 2:45	27.35	4.28
8/2/2006 3:00	27.31	3.99
8/2/2006 3:15	27.26	3.83
8/2/2006 3:30	27.21	3.88
8/2/2006 3:45	27.17	3.82
8/2/2006 4:00	27.1	3.98
8/2/2006 4:15	27.06	3.72
8/2/2006 4:30	27.01	3.82
8/2/2006 4:45	26.97	3.65
8/2/2006 5:00	26.93	3.82
8/2/2006 5:15	26.89	3.71
8/2/2006 5:30	26.85	3.6
8/2/2006 5:45	26.82	3.59
8/2/2006 6:00	26.79	3.63
8/2/2006 6:15	26.75	3.53
8/2/2006 6:30	26.7	3.57
8/2/2006 6:45	26.68	3.45
8/2/2006 7:00	26.63	3.5
8/2/2006 7:15	26.61	3.61
8/2/2006 7:30	26.6	3.37
8/2/2006 7:45	26.57	3.35
8/2/2006 8:00	26.57	3.25
8/2/2006 8:15	26.53	3.27
8/2/2006 8:30	26.52	3.24

8/2/2006 8:45	26.51	3.32
8/2/2006 9:00	26.51	3.09
8/2/2006 9:15	26.5	3.17
8/2/2006 9:30	26.5	3
8/2/2006 9:45	26.5	3.23
8/2/2006 10:00	26.52	3.05
8/2/2006 10:15	26.54	3.06
8/2/2006 10:30	26.6	3
8/2/2006 10:45	26.64	2.8
8/2/2006 11:00	26.69	2.97
8/2/2006 11:15	26.81	3.05
8/2/2006 11:30	26.99	3.08
8/2/2006 11:45	27.11	3.2
8/2/2006 12:00	27.22	3.4
8/2/2006 12:15	27.42	3.99
8/2/2006 12:30	27.9	4.28
8/2/2006 12:45	28.12	4.45
8/2/2006 13:00	28.36	4.54
8/2/2006 13:15	28.71	4.83
8/2/2006 13:30	29	4.63
8/2/2006 13:45	29.28	4.68
8/2/2006 14:00	29.55	4.71
8/2/2006 14:15	29.82	4.93
8/2/2006 14:30	30.03	4.83
8/2/2006 14:45	30.22	5.12
8/2/2006 15:00	30.48	5.05
8/2/2006 15:15	30.25	4.71
8/2/2006 15:30	30.62	5.19
8/2/2006 15:45	30.46	4.62
8/2/2006 16:00	30.45	4.47
8/2/2006 16:15	30.42	4.51
8/2/2006 16:30	30.35	4.34
8/2/2006 16:45	30.34	4.26
8/2/2006 17:00	30.37	4.31
8/2/2006 17:15	30.27	4.12
8/2/2006 17:30	30.26	3.92
8/2/2006 17:45	30.21	3.94
8/2/2006 18:00	30.2	3.93
8/2/2006 18:15	30.16	4.22
8/2/2006 18:30	30.14	4.11
8/2/2006 18:45	30.1	4.09
8/2/2006 19:00	30.06	4.43
8/2/2006 19:15	29.93	4.11
8/2/2006 19:30	29.91	4.22
8/2/2006 19:45	29.88	4.31
8/2/2006 20:00	29.76	4.15
8/2/2006 20:15	29.72	4.05
8/2/2006 20:30	29.69	4.16
8/2/2006 20:45	29.62	4.1
8/2/2006 21:00	29.54	4.31

8/2/2006 21:15	29.47	3.99
8/2/2006 21:30	29.36	4.04
8/2/2006 21:45	29.26	4.03
8/2/2006 22:00	29.16	3.89
8/2/2006 22:15	29.04	3.82
8/2/2006 22:30	28.95	3.6
8/2/2006 22:45	28.84	3.9
8/2/2006 23:00	28.75	3.77
8/2/2006 23:15	28.68	3.79
8/2/2006 23:30	28.61	3.82
8/2/2006 23:45	28.54	3.89
8/3/2006 0:00	28.47	3.93
8/3/2006 0:15	28.34	3.8
8/3/2006 0:30	28.31	3.85
8/3/2006 0:45	28.23	3.79
8/3/2006 1:00	28.16	3.8
8/3/2006 1:15	28.07	3.72
8/3/2006 1:30	27.98	3.68
8/3/2006 1:45	27.91	3.6
8/3/2006 2:00	27.84	3.56
8/3/2006 2:15	27.76	3.57
8/3/2006 2:30	27.7	3.6
8/3/2006 2:45	27.63	3.65
8/3/2006 3:00	27.56	3.77
8/3/2006 3:15	27.49	3.76
8/3/2006 3:30	27.43	3.7
8/3/2006 3:45	27.35	3.84
8/3/2006 4:00	27.3	3.81
8/3/2006 4:15	27.25	3.85
8/3/2006 4:30	27.19	3.86
8/3/2006 4:45	27.13	3.89
8/3/2006 5:00	27.08	4.02
8/3/2006 5:15	27	3.82
8/3/2006 5:30	26.95	3.86
8/3/2006 5:45	26.9	3.87
8/3/2006 6:00	26.84	3.91
8/3/2006 6:15	26.81	3.73
8/3/2006 6:30	26.76	3.65
8/3/2006 6:45	26.68	3.64
8/3/2006 7:00	26.65	3.65
8/3/2006 7:15	26.6	3.62
8/3/2006 7:30	26.59	3.59
8/3/2006 7:45	26.56	3.74
8/3/2006 8:00	26.55	3.56
8/3/2006 8:15	26.55	3.54
8/3/2006 8:30	26.53	3.43
8/3/2006 8:45	26.51	3.45
8/3/2006 9:00	26.5	3.62
8/3/2006 9:15	26.52	3.57
8/3/2006 9:30	26.53	3.41

8/3/2006 9:45	26.57	3.36
8/3/2006 10:00	26.6	3.46
8/3/2006 10:15	26.62	3.36
8/3/2006 10:30	26.67	3.39
8/3/2006 10:45	26.69	3.28
8/3/2006 11:00	26.76	3.29
8/3/2006 11:15	26.89	3.6
8/3/2006 11:30	27.05	3.43

Eureka Midge Data Report
****
Start time [Day] : 8/28/2006 12:45
Down load time [Day] : 8/31/2006 16:45
Sample interval [Minute(s)] : 00:15
Battery status at down load : OK
Samples collected : 304
****

Notes:
****
Logger: Eureka Midge
Sampling Station: NFSR #9
****

Date	Time	Water Temperature	Dissolved Oxygen
8/28/2006	12:45:00	25.9	2.51
8/28/2006	13:00:00	25.9	2.22
8/28/2006	13:15:00	25.9	2.15
8/28/2006	13:30:00	25.9	2.18
8/28/2006	13:45:00	25.9	2.13
8/28/2006	14:00:00	26.3	2.13
8/28/2006	14:15:00	26.2	2.48
8/28/2006	14:30:00	26.3	2.39
8/28/2006	14:45:00	26.3	2.48
8/28/2006	15:00:00	26.3	2.28
8/28/2006	15:15:00	26.4	2.09
8/28/2006	15:30:00	26.3	2.11
8/28/2006	15:45:00	26.3	2.13
8/28/2006	16:00:00	26.3	2.16
8/28/2006	16:15:00	26.3	2.15
8/28/2006	16:30:00	26.3	2.1
8/28/2006	16:45:00	26.5	2.04
8/28/2006	17:00:00	26.4	1.99
8/28/2006	17:15:00	26.4	1.9
8/28/2006	17:30:00	26.5	1.85
8/28/2006	17:45:00	26.5	1.8
8/28/2006	18:00:00	26.4	1.77
8/28/2006	18:15:00	26.4	1.76
8/28/2006	18:30:00	26.4	1.73
8/28/2006	18:45:00	26.4	1.68
8/28/2006	19:00:00	26.4	1.63
8/28/2006	19:15:00	26.4	1.56
8/28/2006	19:30:00	26.4	1.58
8/28/2006	19:45:00	26.4	1.53
8/28/2006	20:00:00	26.4	1.59
8/28/2006	20:15:00	26.3	1.45
8/28/2006	20:30:00	26.3	1.47
8/28/2006	20:45:00	26.3	1.42
8/28/2006	21:00:00	26.2	1.39

8/28/2006	21:15:00	26.2	1.41
8/28/2006	21:30:00	26.1	1.41
8/28/2006	21:45:00	26.1	1.45
8/28/2006	22:00:00	26	1.38
8/28/2006	22:15:00	26	1.41
8/28/2006	22:30:00	25.9	1.4
8/28/2006	22:45:00	25.9	1.35
8/28/2006	23:00:00	25.9	1.11
8/28/2006	23:15:00	25.8	1.23
8/28/2006	23:30:00	25.7	1.37
8/28/2006	23:45:00	25.7	1.35
8/29/2006	0:00:00	25.6	1.35
8/29/2006	0:15:00	25.6	1.29
8/29/2006	0:30:00	25.5	1.31
8/29/2006	0:45:00	25.4	1.29
8/29/2006	1:00:00	25.3	1.26
8/29/2006	1:15:00	25.3	1.27
8/29/2006	1:30:00	25.2	1.25
8/29/2006	1:45:00	25.2	1.23
8/29/2006	2:00:00	25.1	1.19
8/29/2006	2:15:00	25.1	1.21
8/29/2006	2:30:00	25	1.2
8/29/2006	2:45:00	24.9	1.19
8/29/2006	3:00:00	24.8	1.18
8/29/2006	3:15:00	24.8	1.19
8/29/2006	3:30:00	24.7	1.16
8/29/2006	3:45:00	24.7	1.13
8/29/2006	4:00:00	24.6	1.15
8/29/2006	4:15:00	24.6	1.13
8/29/2006	4:30:00	24.5	1.1
8/29/2006	4:45:00	24.4	1.12
8/29/2006	5:00:00	24.4	1.1
8/29/2006	5:15:00	24.3	1.11
8/29/2006	5:30:00	24.2	1.13
8/29/2006	5:45:00	24.1	1.13
8/29/2006	6:00:00	24.1	1.11
8/29/2006	6:15:00	24.1	1.11
8/29/2006	6:30:00	24	1.11
8/29/2006	6:45:00	23.9	1.12
8/29/2006	7:00:00	23.9	1.12
8/29/2006	7:15:00	23.8	1.12
8/29/2006	7:30:00	23.8	1.1
8/29/2006	7:45:00	23.7	1.06
8/29/2006	8:00:00	23.7	1.07
8/29/2006	8:15:00	23.6	1.09
8/29/2006	8:30:00	23.5	1.1
8/29/2006	8:45:00	23.5	1.13
8/29/2006	9:00:00	23.5	1.15
8/29/2006	9:15:00	23.4	1.13
8/29/2006	9:30:00	23.4	1.1

8/29/2006	9:45:00	23.3	1.07
8/29/2006	10:00:00	23.3	1.09
8/29/2006	10:15:00	23.2	1.09
8/29/2006	10:30:00	23.3	1.11
8/29/2006	10:45:00	23.3	1.2
8/29/2006	11:00:00	23.3	1.2
8/29/2006	11:15:00	23.3	1.23
8/29/2006	11:30:00	23.3	1.22
8/29/2006	11:45:00	23.3	1.24
8/29/2006	12:00:00	23.3	1.27
8/29/2006	12:15:00	23.3	1.33
8/29/2006	12:30:00	23.3	1.31
8/29/2006	12:45:00	23.3	1.33
8/29/2006	13:00:00	23.2	1.34
8/29/2006	13:15:00	23.2	1.38
8/29/2006	13:30:00	23.2	1.4
8/29/2006	13:45:00	23.2	1.43
8/29/2006	14:00:00	23.2	1.53
8/29/2006	14:15:00	23.3	1.56
8/29/2006	14:30:00	23.3	1.62
8/29/2006	14:45:00	23.3	1.68
8/29/2006	15:00:00	23.3	1.72
8/29/2006	15:15:00	23.3	1.74
8/29/2006	15:30:00	23.4	1.7
8/29/2006	15:45:00	23.4	1.69
8/29/2006	16:00:00	23.3	1.74
8/29/2006	16:15:00	23.3	1.75
8/29/2006	16:30:00	23.3	1.78
8/29/2006	16:45:00	23.3	1.8
8/29/2006	17:00:00	23.3	1.8
8/29/2006	17:15:00	23.3	1.85
8/29/2006	17:30:00	23.3	1.86
8/29/2006	17:45:00	23.3	1.87
8/29/2006	18:00:00	23.3	1.85
8/29/2006	18:15:00	23.3	1.84
8/29/2006	18:30:00	23.3	1.87
8/29/2006	18:45:00	23.3	1.87
8/29/2006	19:00:00	23.3	1.85
8/29/2006	19:15:00	23.2	1.82
8/29/2006	19:30:00	23.2	1.81
8/29/2006	19:45:00	23.1	1.81
8/29/2006	20:00:00	23.1	1.72
8/29/2006	20:15:00	23	1.64
8/29/2006	20:30:00	23	1.65
8/29/2006	20:45:00	22.9	1.65
8/29/2006	21:00:00	22.9	1.56
8/29/2006	21:15:00	22.9	1.51
8/29/2006	21:30:00	22.8	1.47
8/29/2006	21:45:00	22.8	1.4
8/29/2006	22:00:00	22.7	1.49

8/29/2006	22:15:00	22.7	1.41
8/29/2006	22:30:00	22.7	1.33
8/29/2006	22:45:00	22.7	1.3
8/29/2006	23:00:00	22.6	1.28
8/29/2006	23:15:00	22.6	1.25
8/29/2006	23:30:00	22.5	1.23
8/29/2006	23:45:00	22.5	1.24
8/30/2006	0:00:00	22.4	1.28
8/30/2006	0:15:00	22.4	1.29
8/30/2006	0:30:00	22.4	1.36
8/30/2006	0:45:00	22.3	1.39
8/30/2006	1:00:00	22.3	1.4
8/30/2006	1:15:00	22.3	1.28
8/30/2006	1:30:00	22.2	1.33
8/30/2006	1:45:00	22.2	1.3
8/30/2006	2:00:00	22.1	1.23
8/30/2006	2:15:00	22.1	1.08
8/30/2006	2:30:00	22.1	1.06
8/30/2006	2:45:00	22	1.26
8/30/2006	3:00:00	22	1.3
8/30/2006	3:15:00	21.9	1.29
8/30/2006	3:30:00	21.9	1.29
8/30/2006	3:45:00	21.8	1.29
8/30/2006	4:00:00	21.8	1.3
8/30/2006	4:15:00	21.8	1.2
8/30/2006	4:30:00	21.8	1.11
8/30/2006	4:45:00	21.8	1.03
8/30/2006	5:00:00	21.8	1.02
8/30/2006	5:15:00	21.7	1.04
8/30/2006	5:30:00	21.6	1.09
8/30/2006	5:45:00	21.6	1.14
8/30/2006	6:00:00	21.5	1.07
8/30/2006	6:15:00	21.5	1.06
8/30/2006	6:30:00	21.4	1.05
8/30/2006	6:45:00	21.4	1.05
8/30/2006	7:00:00	21.4	1.1
8/30/2006	7:15:00	21.3	1.06
8/30/2006	7:30:00	21.3	1.05
8/30/2006	7:45:00	21.2	1.01
8/30/2006	8:00:00	21.3	1.02
8/30/2006	8:15:00	21.2	1.04
8/30/2006	8:30:00	21.2	1.02
8/30/2006	8:45:00	21.2	1.08
8/30/2006	9:00:00	21.2	1.12
8/30/2006	9:15:00	21.2	1.18
8/30/2006	9:30:00	21.2	1.22
8/30/2006	9:45:00	21.2	1.31
8/30/2006	10:00:00	21.3	1.3
8/30/2006	10:15:00	21.4	1.29
8/30/2006	10:30:00	21.4	1.34

8/30/2006	10:45:00	21.4	1.38
8/30/2006	11:00:00	21.5	1.46
8/30/2006	11:15:00	21.6	1.36
8/30/2006	11:30:00	21.6	1.4
8/30/2006	11:45:00	21.8	1.49
8/30/2006	12:00:00	21.9	1.56
8/30/2006	12:15:00	22.1	1.63
8/30/2006	12:30:00	22.2	1.79
8/30/2006	12:45:00	22.2	2.06
8/30/2006	13:00:00	22.4	2.14
8/30/2006	13:15:00	22.4	2.13
8/30/2006	13:30:00	22.6	2.11
8/30/2006	13:45:00	22.7	2.07
8/30/2006	14:00:00	22.9	2.29
8/30/2006	14:15:00	22.7	2.35
8/30/2006	14:30:00	23	2.43
8/30/2006	14:45:00	23	2.48
8/30/2006	15:00:00	23	2.46
8/30/2006	15:15:00	23.1	2.46
8/30/2006	15:30:00	23	2.59
8/30/2006	15:45:00	23.1	2.88
8/30/2006	16:00:00	23.1	3
8/30/2006	16:15:00	23.1	3
8/30/2006	16:30:00	23.2	2.96
8/30/2006	16:45:00	23.1	3.04
8/30/2006	17:00:00	23.3	3.07
8/30/2006	17:15:00	23.2	3.05
8/30/2006	17:30:00	23.3	3.06
8/30/2006	17:45:00	23.2	2.96
8/30/2006	18:00:00	23.3	2.82
8/30/2006	18:15:00	23.3	2.81
8/30/2006	18:30:00	23.3	2.83
8/30/2006	18:45:00	23.3	2.86
8/30/2006	19:00:00	23.4	2.92
8/30/2006	19:15:00	23.4	3.12
8/30/2006	19:30:00	23.4	3.43
8/30/2006	19:45:00	23.4	3.3
8/30/2006	20:00:00	23.3	3.29
8/30/2006	20:15:00	23.3	3.37
8/30/2006	20:30:00	23.2	3.33
8/30/2006	20:45:00	23.2	3.42
8/30/2006	21:00:00	23.1	3.24
8/30/2006	21:15:00	23	3.22
8/30/2006	21:30:00	23	3.12
8/30/2006	21:45:00	22.9	3.2
8/30/2006	22:00:00	22.9	3.16
8/30/2006	22:15:00	22.8	3.2
8/30/2006	22:30:00	22.7	3.22
8/30/2006	22:45:00	22.7	3.25
8/30/2006	23:00:00	22.6	3.31

8/30/2006	23:15:00	22.6	3.13
8/30/2006	23:30:00	22.6	2.98
8/30/2006	23:45:00	22.5	2.86
8/31/2006	0:00:00	22.5	2.76
8/31/2006	0:15:00	22.4	2.69
8/31/2006	0:30:00	22.4	2.65
8/31/2006	0:45:00	22.3	2.74
8/31/2006	1:00:00	22.2	2.81
8/31/2006	1:15:00	22.2	2.76
8/31/2006	1:30:00	22.1	2.81
8/31/2006	1:45:00	22.1	2.78
8/31/2006	2:00:00	22.1	2.71
8/31/2006	2:15:00	22	2.79
8/31/2006	2:30:00	22	2.8
8/31/2006	2:45:00	21.9	2.81
8/31/2006	3:00:00	21.9	2.82
8/31/2006	3:15:00	21.8	2.77
8/31/2006	3:30:00	21.8	2.75
8/31/2006	3:45:00	21.7	2.8
8/31/2006	4:00:00	21.7	2.76
8/31/2006	4:15:00	21.6	2.82
8/31/2006	4:30:00	21.5	2.81
8/31/2006	4:45:00	21.5	2.78
8/31/2006	5:00:00	21.4	2.75
8/31/2006	5:15:00	21.4	2.76
8/31/2006	5:30:00	21.3	2.77
8/31/2006	5:45:00	21.3	2.76
8/31/2006	6:00:00	21.2	2.72
8/31/2006	6:15:00	21.2	2.75
8/31/2006	6:30:00	21.1	2.75
8/31/2006	6:45:00	21	2.79
8/31/2006	7:00:00	21	2.81
8/31/2006	7:15:00	21	2.78
8/31/2006	7:45:00	20.8	2.82
8/31/2006	8:00:00	20.8	2.51
8/31/2006	8:15:00	20.8	3.47
8/31/2006	8:30:00	20.8	3.38
8/31/2006	8:45:00	20.8	3.42
8/31/2006	9:00:00	20.7	3.45
8/31/2006	9:15:00	20.8	3.52
8/31/2006	9:30:00	20.8	3.35
8/31/2006	9:45:00	20.9	3.33
8/31/2006	10:00:00	20.9	3.38
8/31/2006	10:15:00	20.9	3.4
8/31/2006	10:30:00	20.9	3.38
8/31/2006	10:45:00	21	3.47
8/31/2006	11:00:00	21.1	3.48
8/31/2006	11:15:00	21.2	3.85
8/31/2006	11:30:00	21.3	3.89
8/31/2006	11:45:00	21.3	3.79

8/31/2006	12:00:00	21.5	3.86
8/31/2006	12:15:00	21.7	2.76
8/31/2006	12:30:00	21.7	2.59
8/31/2006	12:45:00	22	3.88
8/31/2006	13:00:00	22	4.11
8/31/2006	13:15:00	22.1	4.17
8/31/2006	13:30:00	22.2	3.97
8/31/2006	13:45:00	22.2	3.83
8/31/2006	14:00:00	22.4	4.2
8/31/2006	14:15:00	22.4	4.37
8/31/2006	14:30:00	22.4	4.54
8/31/2006	14:45:00	22.6	4.66
8/31/2006	15:00:00	22.6	4.93
8/31/2006	15:15:00	22.6	4.99
8/31/2006	15:30:00	22.7	5.42
8/31/2006	15:45:00	22.8	5.43
8/31/2006	16:00:00	22.9	5.61
8/31/2006	16:15:00	22.9	5.36
8/31/2006	16:30:00	23	5.73
8/31/2006	16:45:00	23.9	4.74

AQUA 2002 Data Report
****
Start time [Day] : 8/28/2006 11:15
Down load time [Day] : 9/01/2006 13:00
Sample interval [Minute(s)] : 00:15
Battery status at down load : OK
Samples collected : 392
****

Notes:
****
Prop. #100466
Logger #108
Sampling Station: Horse Creek #1
****

Date/Time	Water Temperature	Dissolved Oxygen
8/28/2006 11:15	25.71	0.9
8/28/2006 11:30	25.88	0.89
8/28/2006 11:45	25.98	0.81
8/28/2006 12:00	26.15	0.87
8/28/2006 12:15	26.38	0.79
8/28/2006 12:30	26.44	0.8
8/28/2006 12:45	26.55	0.89
8/28/2006 13:00	26.6	0.92
8/28/2006 13:15	26.63	0.77
8/28/2006 13:30	26.8	0.88
8/28/2006 13:45	26.95	0.78
8/28/2006 14:00	27.11	0.86
8/28/2006 14:15	27.21	0.98
8/28/2006 14:30	27.36	0.95
8/28/2006 14:45	27.43	0.91
8/28/2006 15:00	27.58	1.01
8/28/2006 15:15	27.61	1.28
8/28/2006 15:30	27.65	1.45
8/28/2006 15:45	27.84	1.61
8/28/2006 16:00	27.86	1.43
8/28/2006 16:15	27.91	1.62
8/28/2006 16:30	27.91	1.58
8/28/2006 16:45	27.92	1.74
8/28/2006 17:00	27.88	1.61
8/28/2006 17:15	27.86	1.49
8/28/2006 17:30	27.8	1.45
8/28/2006 17:45	27.75	1.74
8/28/2006 18:00	27.72	2.03
8/28/2006 18:15	27.67	2.14
8/28/2006 18:30	27.62	1.98
8/28/2006 18:45	27.55	1.72
8/28/2006 19:00	27.47	1.79
8/28/2006 19:15	27.38	1.63

8/28/2006 19:30	27.3	1.71
8/28/2006 19:45	27.2	1.7
8/28/2006 20:00	27.12	1.57
8/28/2006 20:15	27.03	1.51
8/28/2006 20:30	26.9	1.59
8/28/2006 20:45	26.86	1.55
8/28/2006 21:00	26.79	1.39
8/28/2006 21:15	26.71	1.31
8/28/2006 21:30	26.64	1.45
8/28/2006 21:45	26.57	1.3
8/28/2006 22:00	26.46	1.22
8/28/2006 22:15	26.4	1.25
8/28/2006 22:30	26.31	1.11
8/28/2006 22:45	26.22	1
8/28/2006 23:00	26.12	0.9
8/28/2006 23:15	26.04	0.91
8/28/2006 23:30	25.97	0.73
8/28/2006 23:45	25.86	0.86
8/29/2006 0:00	25.79	0.81
8/29/2006 0:15	25.67	0.68
8/29/2006 0:30	25.59	0.77
8/29/2006 0:45	25.51	0.68
8/29/2006 1:00	25.4	0.75
8/29/2006 1:15	25.29	0.71
8/29/2006 1:30	25.25	0.51
8/29/2006 1:45	25.15	0.59
8/29/2006 2:00	25.11	0.48
8/29/2006 2:15	25.04	0.45
8/29/2006 2:30	24.96	0.49
8/29/2006 2:45	24.84	0.44
8/29/2006 3:00	24.77	0.53
8/29/2006 3:15	24.7	0.44
8/29/2006 3:30	24.62	0.43
8/29/2006 3:45	24.59	0.43
8/29/2006 4:00	24.52	0.42
8/29/2006 4:15	24.44	0.45
8/29/2006 4:30	24.35	0.47
8/29/2006 4:45	24.27	0.45
8/29/2006 5:00	24.21	0.47
8/29/2006 5:15	24.14	0.46
8/29/2006 5:30	24.08	0.45
8/29/2006 5:45	24.01	0.44
8/29/2006 6:00	23.93	0.46
8/29/2006 6:15	23.89	0.36
8/29/2006 6:30	23.83	0.42
8/29/2006 6:45	23.77	0.44
8/29/2006 7:00	23.72	0.37
8/29/2006 7:15	23.66	0.38
8/29/2006 7:30	23.61	0.37
8/29/2006 7:45	23.57	0.33

8/29/2006 8:00	23.52	0.28
8/29/2006 8:15	23.46	0.26
8/29/2006 8:30	23.42	0.25
8/29/2006 8:45	23.38	0.26
8/29/2006 9:00	23.35	0.27
8/29/2006 9:15	23.3	0.27
8/29/2006 9:30	23.27	0.26
8/29/2006 9:45	23.23	0.26
8/29/2006 10:00	23.2	0.29
8/29/2006 10:15	23.17	0.32
8/29/2006 10:30	23.15	0.3
8/29/2006 10:45	23.15	0.32
8/29/2006 11:00	23.16	0.33
8/29/2006 11:15	23.16	0.32
8/29/2006 11:30	23.19	0.28
8/29/2006 11:45	23.17	0.36
8/29/2006 12:00	23.16	0.43
8/29/2006 12:15	23.16	0.41
8/29/2006 12:30	23.15	0.45
8/29/2006 12:45	23.13	0.48
8/29/2006 13:00	23.16	0.54
8/29/2006 13:15	23.17	0.48
8/29/2006 13:30	23.2	0.49
8/29/2006 13:45	23.2	0.49
8/29/2006 14:00	23.23	0.51
8/29/2006 14:15	23.23	0.62
8/29/2006 14:30	23.25	0.65
8/29/2006 14:45	23.28	0.6
8/29/2006 15:00	23.3	0.59
8/29/2006 15:15	23.3	0.62
8/29/2006 15:30	23.29	0.62
8/29/2006 15:45	23.28	0.58
8/29/2006 16:00	23.29	0.58
8/29/2006 16:15	23.32	0.73
8/29/2006 16:30	23.31	0.77
8/29/2006 16:45	23.32	0.74
8/29/2006 17:00	23.31	0.77
8/29/2006 17:15	23.31	0.76
8/29/2006 17:30	23.33	0.78
8/29/2006 17:45	23.32	0.79
8/29/2006 18:00	23.33	0.79
8/29/2006 18:15	23.34	0.73
8/29/2006 18:30	23.33	0.77
8/29/2006 18:45	23.31	0.83
8/29/2006 19:00	23.31	0.79
8/29/2006 19:15	23.29	0.77
8/29/2006 19:30	23.26	0.85
8/29/2006 19:45	23.22	0.9
8/29/2006 20:00	23.18	0.9
8/29/2006 20:15	23.12	0.76

8/29/2006 20:30	23.07	0.85
8/29/2006 20:45	23.04	0.74
8/29/2006 21:00	23	0.87
8/29/2006 21:15	22.96	0.81
8/29/2006 21:30	22.93	0.83
8/29/2006 21:45	22.91	0.79
8/29/2006 22:00	22.86	0.71
8/29/2006 22:15	22.83	0.72
8/29/2006 22:30	22.78	0.76
8/29/2006 22:45	22.76	0.87
8/29/2006 23:00	22.68	0.93
8/29/2006 23:15	22.64	0.83
8/29/2006 23:30	22.58	0.82
8/29/2006 23:45	22.54	0.75
8/30/2006 0:00	22.48	0.78
8/30/2006 0:15	22.43	0.82
8/30/2006 0:30	22.4	0.74
8/30/2006 0:45	22.34	0.85
8/30/2006 1:00	22.3	0.72
8/30/2006 1:15	22.26	0.77
8/30/2006 1:30	22.21	0.86
8/30/2006 1:45	22.16	0.76
8/30/2006 2:00	22.11	0.73
8/30/2006 2:15	22.07	0.73
8/30/2006 2:30	22	0.77
8/30/2006 2:45	21.93	0.88
8/30/2006 3:00	21.89	0.84
8/30/2006 3:15	21.85	0.7
8/30/2006 3:30	21.79	0.77
8/30/2006 3:45	21.75	0.73
8/30/2006 4:00	21.7	0.74
8/30/2006 4:15	21.65	0.75
8/30/2006 4:30	21.6	0.7
8/30/2006 4:45	21.57	0.72
8/30/2006 5:00	21.53	0.7
8/30/2006 5:15	21.48	0.66
8/30/2006 5:30	21.42	0.64
8/30/2006 5:45	21.38	0.67
8/30/2006 6:00	21.3	0.7
8/30/2006 6:15	21.25	0.66
8/30/2006 6:30	21.2	0.68
8/30/2006 6:45	21.15	0.68
8/30/2006 7:00	21.1	0.71
8/30/2006 7:15	21.05	0.68
8/30/2006 7:30	21	0.73
8/30/2006 7:45	20.96	0.77
8/30/2006 8:00	20.91	0.74
8/30/2006 8:15	20.89	0.74
8/30/2006 8:30	20.88	0.7
8/30/2006 8:45	20.9	0.61

8/30/2006 9:00	20.93	0.64
8/30/2006 9:15	21.01	0.7
8/30/2006 9:30	21.04	0.7
8/30/2006 9:45	21.12	0.77
8/30/2006 10:00	21.16	0.76
8/30/2006 10:15	21.3	0.82
8/30/2006 10:30	21.42	0.79
8/30/2006 10:45	21.57	0.73
8/30/2006 11:00	21.68	0.6
8/30/2006 11:15	21.81	0.72
8/30/2006 11:30	21.96	0.81
8/30/2006 11:45	22.11	1.21
8/30/2006 12:00	22.25	0.89
8/30/2006 12:15	22.43	0.92
8/30/2006 12:30	22.55	0.89
8/30/2006 12:45	22.65	0.81
8/30/2006 13:00	22.79	1
8/30/2006 13:15	22.95	0.94
8/30/2006 13:30	23.03	0.84
8/30/2006 13:45	23.18	0.8
8/30/2006 14:00	23.3	0.81
8/30/2006 14:15	23.46	1.02
8/30/2006 14:30	23.59	1.09
8/30/2006 14:45	23.68	1.27
8/30/2006 15:00	23.8	1.39
8/30/2006 15:15	23.89	1.2
8/30/2006 15:30	23.95	1.28
8/30/2006 15:45	24.01	1.37
8/30/2006 16:00	24.06	1.33
8/30/2006 16:15	24.11	1.39
8/30/2006 16:30	24.11	1.52
8/30/2006 16:45	24.14	1.53
8/30/2006 17:00	24.16	1.46
8/30/2006 17:15	24.2	1.61
8/30/2006 17:30	24.2	1.51
8/30/2006 17:45	24.21	1.49
8/30/2006 18:00	24.2	1.51
8/30/2006 18:15	24.18	1.48
8/30/2006 18:30	24.19	1.44
8/30/2006 18:45	24.16	1.38
8/30/2006 19:00	24.13	1.31
8/30/2006 19:15	24.11	1.44
8/30/2006 19:30	24.08	1.53
8/30/2006 19:45	24.04	1.71
8/30/2006 20:00	23.95	2.32
8/30/2006 20:15	23.85	2.14
8/30/2006 20:30	23.76	2.15
8/30/2006 20:45	23.67	1.79
8/30/2006 21:00	23.57	1.77
8/30/2006 21:15	23.49	1.69

8/30/2006 21:30	23.44	1.55
8/30/2006 21:45	23.36	1.51
8/30/2006 22:00	23.3	1.42
8/30/2006 22:15	23.23	1.37
8/30/2006 22:30	23.15	1.33
8/30/2006 22:45	23.08	1.31
8/30/2006 23:00	23.01	1.29
8/30/2006 23:15	22.95	1.16
8/30/2006 23:30	22.9	1.26
8/30/2006 23:45	22.85	1.26
8/31/2006 0:00	22.76	1.25
8/31/2006 0:15	22.71	1.13
8/31/2006 0:30	22.59	1.17
8/31/2006 0:45	22.56	1.11
8/31/2006 1:00	22.47	1.06
8/31/2006 1:15	22.41	1.1
8/31/2006 1:30	22.32	1.07
8/31/2006 1:45	22.24	1.08
8/31/2006 2:00	22.2	1.05
8/31/2006 2:15	22.13	1.03
8/31/2006 2:30	22.07	1.06
8/31/2006 2:45	22	1.04
8/31/2006 3:00	21.92	1.05
8/31/2006 3:15	21.84	1
8/31/2006 3:30	21.8	0.98
8/31/2006 3:45	21.72	1.06
8/31/2006 4:00	21.66	1
8/31/2006 4:15	21.6	1
8/31/2006 4:30	21.52	0.91
8/31/2006 4:45	21.47	0.92
8/31/2006 5:00	21.4	0.89
8/31/2006 5:15	21.36	0.87
8/31/2006 5:30	21.3	0.78
8/31/2006 5:45	21.23	0.8
8/31/2006 6:00	21.13	0.89
8/31/2006 6:15	21.1	0.77
8/31/2006 6:30	21.04	0.88
8/31/2006 6:45	20.99	0.81
8/31/2006 7:00	20.92	0.82
8/31/2006 7:15	20.86	0.86
8/31/2006 7:30	20.83	0.74
8/31/2006 7:45	20.75	0.78
8/31/2006 8:00	20.77	0.79
8/31/2006 8:15	20.78	0.77
8/31/2006 8:30	20.73	0.73
8/31/2006 8:45	20.72	0.71
8/31/2006 9:00	20.73	0.68
8/31/2006 9:15	20.74	0.6
8/31/2006 9:30	20.82	0.52
8/31/2006 9:45	20.89	0.53

8/31/2006 10:00	20.96	0.47
8/31/2006 10:15	21.05	0.59
8/31/2006 10:30	21.18	0.57
8/31/2006 10:45	21.28	0.59
8/31/2006 11:00	21.41	0.48
8/31/2006 11:15	21.54	0.54
8/31/2006 11:30	21.71	0.6
8/31/2006 11:45	21.83	1.22
8/31/2006 12:00	21.97	1
8/31/2006 12:15	22.04	0.7
8/31/2006 12:30	22.12	0.87
8/31/2006 12:45	22.19	0.82
8/31/2006 13:00	22.31	0.9
8/31/2006 13:15	22.42	0.89
8/31/2006 13:30	22.59	0.75
8/31/2006 13:45	22.72	0.78
8/31/2006 14:00	22.87	0.81
8/31/2006 14:15	22.94	0.91
8/31/2006 14:30	23.1	0.89
8/31/2006 14:45	23.27	0.99
8/31/2006 15:00	23.3	0.76
8/31/2006 15:15	23.33	0.68
8/31/2006 15:30	23.41	0.67
8/31/2006 15:45	23.47	0.64
8/31/2006 16:00	23.49	0.87
8/31/2006 16:15	23.62	1.02
8/31/2006 16:30	23.65	0.97
8/31/2006 16:45	23.72	0.9
8/31/2006 17:00	23.74	0.98
8/31/2006 17:15	23.67	1.06
8/31/2006 17:30	23.72	1.08
8/31/2006 17:45	23.74	1.2
8/31/2006 18:00	23.75	1.12
8/31/2006 18:15	23.77	1.26
8/31/2006 18:30	23.75	0.92
8/31/2006 18:45	23.73	1.24
8/31/2006 19:00	23.74	1.26
8/31/2006 19:15	23.72	1.02
8/31/2006 19:30	23.71	1.07
8/31/2006 19:45	23.63	1.22
8/31/2006 20:00	23.62	1.49
8/31/2006 20:15	23.53	1.78
8/31/2006 20:30	23.44	1.99
8/31/2006 20:45	23.36	1.82
8/31/2006 21:00	23.26	1.79
8/31/2006 21:15	23.18	1.73
8/31/2006 21:30	23.09	1.55
8/31/2006 21:45	23.03	1.51
8/31/2006 22:00	22.97	1.27
8/31/2006 22:15	22.91	1.29

8/31/2006 22:30	22.84	1.22
8/31/2006 22:45	22.77	1.2
8/31/2006 23:00	22.72	1.16
8/31/2006 23:15	22.67	1.03
8/31/2006 23:30	22.6	1.14
8/31/2006 23:45	22.55	0.89
9/1/2006 0:00	22.46	0.85
9/1/2006 0:15	22.43	0.93
9/1/2006 0:30	22.39	0.92
9/1/2006 0:45	22.34	0.86
9/1/2006 1:00	22.26	0.84
9/1/2006 1:15	22.19	0.76
9/1/2006 1:30	22.12	0.79
9/1/2006 1:45	22.03	0.76
9/1/2006 2:00	22	0.77
9/1/2006 2:15	21.95	0.68
9/1/2006 2:30	21.87	0.76
9/1/2006 2:45	21.81	0.7
9/1/2006 3:00	21.77	0.71
9/1/2006 3:15	21.7	0.73
9/1/2006 3:30	21.65	0.66
9/1/2006 3:45	21.56	0.65
9/1/2006 4:00	21.53	0.58
9/1/2006 4:15	21.47	0.63
9/1/2006 4:30	21.38	0.62
9/1/2006 4:45	21.33	0.56
9/1/2006 5:00	21.26	0.62
9/1/2006 5:15	21.18	0.58
9/1/2006 5:30	21.15	0.52
9/1/2006 5:45	21.1	0.61
9/1/2006 6:00	21.04	0.54
9/1/2006 6:15	21.03	0.51
9/1/2006 6:30	20.95	0.47
9/1/2006 6:45	20.91	0.5
9/1/2006 7:00	20.86	0.5
9/1/2006 7:15	20.83	0.52
9/1/2006 7:30	20.78	0.52
9/1/2006 7:45	20.73	0.53
9/1/2006 8:00	20.72	0.52
9/1/2006 8:15	20.68	0.53
9/1/2006 8:30	20.68	0.44
9/1/2006 8:45	20.71	0.41
9/1/2006 9:00	20.73	0.44
9/1/2006 9:15	20.75	0.37
9/1/2006 9:30	20.8	0.43
9/1/2006 9:45	20.83	0.38
9/1/2006 10:00	20.93	0.31
9/1/2006 10:15	20.99	0.25
9/1/2006 10:30	21.08	0.29
9/1/2006 10:45	21.23	0.26

9/1/2006 11:00	21.34	0.29
9/1/2006 11:15	21.44	0.34
9/1/2006 11:30	21.55	0.29
9/1/2006 11:45	21.66	0.4
9/1/2006 12:00	21.8	0.39
9/1/2006 12:15	21.97	0.19
9/1/2006 12:30	22.14	0.22
9/1/2006 12:45	22.27	0.21
9/1/2006 13:00	22.72	1.29

Appendix E

Statistical Analyses Comparing Benthic Sediment Between Sampling Stations. One-Way ANOVA, Square-root Transformed, and Student-Newman-Keuls Multiple Comparison Test Were Used to Test Differences in Total Benthic Sediment (Sand + Silt) and Silt. Kruskal-Wallis ANOVA on Ranks and Student-Newman-Keuls Multiple Comparison Test Were Used to Test Differences in Sand.

One Way Analysis of Variance Tuesday, February 19, 2008, 1:57:31 PM

Data source: Benthic Sediment

Dependent Variable: sqrt (total benthic sediment)

Normality Test: Passed (P = 0.430)

Equal Variance Test: Passed (P = 0.076)

Group Name	**N**	**Missing**	**Mean**	**Std Dev**	**SEM**
NFSR #1	10	0	187.871	59.278	18.745
NFSR #2	10	0	261.728	75.827	23.978
NFSR #3	10	0	313.875	34.574	10.933
NFSR #4	10	0	290.631	39.953	12.634
NFSR #5	10	0	449.519	60.416	19.105
NFSR #6	10	0	290.088	78.275	24.753
NFSR #7	10	0	162.549	59.186	18.716
NFSR #8	10	0	306.336	82.797	26.183
NFSR #9	10	0	239.528	89.507	28.305
NFSR #10	10	0	350.927	81.774	25.859
Horse Ck #1	10	0	277.300	63.012	19.926
Cedar Ck #1	10	0	239.337	115.994	36.680
LDC #1	10	0	358.181	76.478	24.184
LDC #2	10	0	400.688	78.968	24.972

Source of Variation	**DF**	**SS**	**MS**	**F**	**P**
Between Groups	13	793092.447	61007.111	11.179	<0.001
Residual	126	687590.664	5457.069		
Total	139	1480683.111			

The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001).

Power of performed test with alpha = 0.050: 1.000

All Pairwise Multiple Comparison Procedures (Student-Newman-Keuls Method):

Comparisons for factor: **Station**

Comparison	**Diff of Means**	**p**	**q**	**P**	**P<0.050**
NFSR #5 vs. NFSR #7	286.970	14	12.284	<0.001	Yes
NFSR #5 vs. NFSR #1	261.648	13	11.201	<0.001	Yes
NFSR #5 vs. Cedar Ck #1	210.182	12	8.997	<0.001	Yes
NFSR #5 vs. NFSR #9	209.991	11	8.989	<0.001	Yes
NFSR #5 vs. NFSR #2	187.791	10	8.039	<0.001	Yes
NFSR #5 vs. Horse Ck #1	172.219	9	7.372	<0.001	Yes
NFSR #5 vs. NFSR #6	159.431	8	6.825	<0.001	Yes
NFSR #5 vs. NFSR #4	158.888	7	6.802	<0.001	Yes
NFSR #5 vs. NFSR #8	143.183	6	6.129	<0.001	Yes
NFSR #5 vs. NFSR #3	135.644	5	5.807	<0.001	Yes
NFSR #5 vs. NFSR #10	98.592	4	4.220	0.015	Yes
NFSR #5 vs. LDC #1	91.338	3	3.910	0.016	Yes
NFSR #5 vs. LDC #2	48.831	2	2.090	0.139	No
LDC #2 vs. NFSR #7	238.139	13	10.194	<0.001	Yes

LDC #2 vs. NFSR #1	212.817	12	9.110	<0.001	Yes
LDC #2 vs. Cedar Ck #1	161.351	11	6.907	<0.001	Yes
LDC #2 vs. NFSR #9	161.160	10	6.899	<0.001	Yes
LDC #2 vs. NFSR #2	138.960	9	5.949	<0.001	Yes
LDC #2 vs. Horse Ck #1	123.387	8	5.282	0.005	Yes
LDC #2 vs. NFSR #6	110.600	7	4.734	0.014	Yes
LDC #2 vs. NFSR #4	110.056	6	4.711	0.011	Yes
LDC #2 vs. NFSR #8	94.352	5	4.039	0.035	Yes
LDC #2 vs. NFSR #3	86.813	4	3.716	0.043	Yes
LDC #2 vs. NFSR #10	49.760	3	2.130	0.288	No
LDC #2 vs. LDC #1	42.507	2	1.820	0.198	Do Not Test
LDC #1 vs. NFSR #7	195.632	12	8.375	<0.001	Yes
LDC #1 vs. NFSR #1	170.310	11	7.291	<0.001	Yes
LDC #1 vs. Cedar Ck #1	118.844	10	5.087	0.012	Yes
LDC #1 vs. NFSR #9	118.653	9	5.079	0.010	Yes
LDC #1 vs. NFSR #2	96.453	8	4.129	0.069	No
LDC #1 vs. Horse Ck #1	80.881	7	3.462	0.179	Do Not Test
LDC #1 vs. NFSR #6	68.093	6	2.915	0.308	Do Not Test
LDC #1 vs. NFSR #4	67.549	5	2.892	0.245	Do Not Test
LDC #1 vs. NFSR #8	51.845	4	2.219	0.396	Do Not Test
LDC #1 vs. NFSR #3	44.306	3	1.897	0.372	Do Not Test
LDC #1 vs. NFSR #10	7.254	2	0.311	0.826	Do Not Test
NFSR #10 vs. NFSR #7	188.378	11	8.064	<0.001	Yes
NFSR #10 vs. NFSR #1	163.057	10	6.980	<0.001	Yes
NFSR #10 vs. Cedar Ck #1	111.590	9	4.777	0.021	Yes
NFSR #10 vs. NFSR #9	111.399	8	4.769	0.017	Yes
NFSR #10 vs. NFSR #2	89.200	7	3.818	0.098	Do Not Test
NFSR #10 vs. Horse Ck #1	73.627	6	3.152	0.224	Do Not Test
NFSR #10 vs. NFSR #6	60.839	5	2.604	0.350	Do Not Test
NFSR #10 vs. NFSR #4	60.296	4	2.581	0.261	Do Not Test
NFSR #10 vs. NFSR #8	44.592	3	1.909	0.368	Do Not Test
NFSR #10 vs. NFSR #3	37.052	2	1.586	0.262	Do Not Test
NFSR #3 vs. NFSR #7	151.326	10	6.478	<0.001	Yes
NFSR #3 vs. NFSR #1	126.004	9	5.394	0.004	Yes
NFSR #3 vs. Cedar Ck #1	74.538	8	3.191	0.318	No
NFSR #3 vs. NFSR #9	74.347	7	3.183	0.269	Do Not Test
NFSR #3 vs. NFSR #2	52.147	6	2.232	0.613	Do Not Test
NFSR #3 vs. Horse Ck #1	36.575	5	1.566	0.803	Do Not Test
NFSR #3 vs. NFSR #6	23.787	4	1.018	0.889	Do Not Test
NFSR #3 vs. NFSR #4	23.244	3	0.995	0.761	Do Not Test
NFSR #3 vs. NFSR #8	7.539	2	0.323	0.819	Do Not Test
NFSR #8 vs. NFSR #7	143.787	9	6.155	<0.001	Yes
NFSR #8 vs. NFSR #1	118.465	8	5.071	0.008	Yes
NFSR #8 vs. Cedar Ck #1	66.999	7	2.868	0.397	Do Not Test
NFSR #8 vs. NFSR #9	66.808	6	2.860	0.330	Do Not Test
NFSR #8 vs. NFSR #2	44.608	5	1.910	0.660	Do Not Test
NFSR #8 vs. Horse Ck #1	29.035	4	1.243	0.816	Do Not Test
NFSR #8 vs. NFSR #6	16.248	3	0.696	0.875	Do Not Test
NFSR #8 vs. NFSR #4	15.704	2	0.672	0.635	Do Not Test
NFSR #4 vs. NFSR #7	128.082	8	5.483	0.003	Yes
NFSR #4 vs. NFSR #1	102.761	7	4.399	0.031	Yes
NFSR #4 vs. Cedar Ck #1	51.294	6	2.196	0.630	Do Not Test
NFSR #4 vs. NFSR #9	51.103	5	2.188	0.532	Do Not Test
NFSR #4 vs. NFSR #2	28.904	4	1.237	0.818	Do Not Test
NFSR #4 vs. Horse Ck #1	13.331	3	0.571	0.914	Do Not Test
NFSR #4 vs. NFSR #6	0.543	2	0.0233	0.987	Do Not Test

NFSR #6 vs. NFSR #7	127.539	7	5.460	0.002	Yes
NFSR #6 vs. NFSR #1	102.217	6	4.376	0.024	Yes
NFSR #6 vs. Cedar Ck #1	50.751	5	2.173	0.539	Do Not Test
NFSR #6 vs. NFSR #9	50.560	4	2.164	0.419	Do Not Test
NFSR #6 vs. NFSR #2	28.360	3	1.214	0.667	Do Not Test
NFSR #6 vs. Horse Ck #1	12.788	2	0.547	0.699	Do Not Test
Horse Ck #1 vs. NFSR #7	114.751	6	4.912	0.007	Yes
Horse Ck #1 vs. NFSR #1	89.430	5	3.828	0.053	No
Horse Ck #1 vs. Cedar Ck #1	37.963	4	1.625	0.659	Do Not Test
Horse Ck #1 vs. NFSR #9	37.772	3	1.617	0.487	Do Not Test
Horse Ck #1 vs. NFSR #2	15.573	2	0.667	0.637	Do Not Test
NFSR #2 vs. NFSR #7	99.179	5	4.246	0.023	Yes
NFSR #2 vs. NFSR #1	73.857	4	3.162	0.114	Do Not Test
NFSR #2 vs. Cedar Ck #1	22.391	3	0.958	0.776	Do Not Test
NFSR #2 vs. NFSR #9	22.200	2	0.950	0.502	Do Not Test
NFSR #9 vs. NFSR #7	76.979	4	3.295	0.091	No
NFSR #9 vs. NFSR #1	51.658	3	2.211	0.262	Do Not Test
NFSR #9 vs. Cedar Ck #1	0.191	2	0.00818	0.995	Do Not Test
Cedar Ck #1 vs. NFSR #7	76.788	3	3.287	0.053	Do Not Test
Cedar Ck #1 vs. NFSR #1	51.466	2	2.203	0.119	Do Not Test
NFSR #1 vs. NFSR #7	25.321	2	1.084	0.443	Do Not Test

A result of "Do Not Test" occurs for a comparison when no significant difference is found between two means that enclose that comparison. For example, if you had four means sorted in order, and found no difference between means 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed means is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the means, even though one may appear to exist.

One Way Analysis of Variance Tuesday, February 19, 2008, 2:09:29 PM

Data source: Benthic Sediment

Dependent Variable: sqrt(silt)

Normality Test: Passed (P = 0.250)

Equal Variance Test: Passed (P = 0.134)

Group Name	N	Missing	Mean	Std Dev	SEM
NFSR #1	10	0	181.637	59.318	18.758
NFSR #2	10	0	235.770	79.249	25.061
NFSR #3	10	0	262.206	26.651	8.428
NFSR #4	10	0	252.381	36.534	11.553
NFSR #5	10	0	416.600	67.517	21.351
NFSR #6	10	0	261.696	78.208	24.732
NFSR #7	10	0	145.485	55.435	17.530
NFSR #8	10	0	284.431	84.755	26.802
NFSR #9	10	0	222.306	76.277	24.121
NFSR #10	10	0	329.573	73.589	23.271
Horse Ck #1	10	0	210.194	47.256	14.944
Cedar Ck #1	10	0	219.793	109.752	34.707
LDC #1	10	0	323.182	85.908	27.166
LDC #2	10	0	335.899	65.862	20.827

Source of Variation	DF	SS	MS	F	P
Between Groups	13	650181.004	50013.923	10.002	<0.001
Residual	126	630049.878	5000.396		
Total	139	1280230.883			

The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001).

Power of performed test with alpha = 0.050: 1.000

All Pairwise Multiple Comparison Procedures (Student-Newman-Keuls Method):

Comparisons for factor: **Station**

Comparison	Diff of Means	p	q	P	P<0.050
NFSR #5 vs. NFSR #7	271.115	14	12.124	<0.001	Yes
NFSR #5 vs. NFSR #1	234.963	13	10.507	<0.001	Yes
NFSR #5 vs. Horse Ck #1	206.407	12	9.230	<0.001	Yes
NFSR #5 vs. Cedar Ck #1	196.808	11	8.801	<0.001	Yes
NFSR #5 vs. NFSR #9	194.295	10	8.689	<0.001	Yes
NFSR #5 vs. NFSR #2	180.830	9	8.087	<0.001	Yes
NFSR #5 vs. NFSR #4	164.219	8	7.344	<0.001	Yes
NFSR #5 vs. NFSR #6	154.905	7	6.927	<0.001	Yes
NFSR #5 vs. NFSR #3	154.394	6	6.904	<0.001	Yes
NFSR #5 vs. NFSR #8	132.169	5	5.911	<0.001	Yes
NFSR #5 vs. LDC #1	93.418	4	4.178	0.017	Yes
NFSR #5 vs. NFSR #10	87.027	3	3.892	0.016	Yes
NFSR #5 vs. LDC #2	80.701	2	3.609	0.011	Yes
LDC #2 vs. NFSR #7	190.414	13	8.515	<0.001	Yes

LDC #2 vs. NFSR #1	154.262	12	6.899	<0.001	Yes
LDC #2 vs. Horse Ck #1	125.705	11	5.621	0.003	Yes
LDC #2 vs. Cedar Ck #1	116.106	10	5.192	0.009	Yes
LDC #2 vs. NFSR #9	113.593	9	5.080	0.010	Yes
LDC #2 vs. NFSR #2	100.129	8	4.478	0.033	Yes
LDC #2 vs. NFSR #4	83.518	7	3.735	0.114	No
LDC #2 vs. NFSR #6	74.203	6	3.318	0.176	Do Not Test
LDC #2 vs. NFSR #3	73.693	5	3.296	0.135	Do Not Test
LDC #2 vs. NFSR #8	51.468	4	2.302	0.363	Do Not Test
LDC #2 vs. LDC #1	12.717	3	0.569	0.915	Do Not Test
LDC #2 vs. NFSR #10	6.326	2	0.283	0.841	Do Not Test
NFSR #10 vs. NFSR #7	184.088	12	8.232	<0.001	Yes
NFSR #10 vs. NFSR #1	147.936	11	6.616	<0.001	Yes
NFSR #10 vs. Horse Ck #1	119.380	10	5.339	0.006	Yes
NFSR #10 vs. Cedar Ck #1	109.781	9	4.909	0.015	Yes
NFSR #10 vs. NFSR #9	107.268	8	4.797	0.016	Yes
NFSR #10 vs. NFSR #2	93.803	7	4.195	0.047	Yes
NFSR #10 vs. NFSR #4	77.192	6	3.452	0.142	Do Not Test
NFSR #10 vs. NFSR #6	67.878	5	3.035	0.201	Do Not Test
NFSR #10 vs. NFSR #3	67.367	4	3.013	0.144	Do Not Test
NFSR #10 vs. NFSR #8	45.142	3	2.019	0.327	Do Not Test
NFSR #10 vs. LDC #1	6.391	2	0.286	0.840	Do Not Test
LDC #1 vs. NFSR #7	177.697	11	7.947	<0.001	Yes
LDC #1 vs. NFSR #1	141.545	10	6.330	<0.001	Yes
LDC #1 vs. Horse Ck #1	112.988	9	5.053	0.011	Yes
LDC #1 vs. Cedar Ck #1	103.389	8	4.624	0.024	Yes
LDC #1 vs. NFSR #9	100.877	7	4.511	0.024	Yes
LDC #1 vs. NFSR #2	87.412	6	3.909	0.063	No
LDC #1 vs. NFSR #4	70.801	5	3.166	0.165	Do Not Test
LDC #1 vs. NFSR #6	61.486	4	2.750	0.210	Do Not Test
LDC #1 vs. NFSR #3	60.976	3	2.727	0.131	Do Not Test
LDC #1 vs. NFSR #8	38.751	2	1.733	0.220	Do Not Test
NFSR #8 vs. NFSR #7	138.946	10	6.214	<0.001	Yes
NFSR #8 vs. NFSR #1	102.794	9	4.597	0.032	Yes
NFSR #8 vs. Horse Ck #1	74.237	8	3.320	0.268	No
NFSR #8 vs. Cedar Ck #1	64.638	7	2.891	0.387	Do Not Test
NFSR #8 vs. NFSR #9	62.126	6	2.778	0.363	Do Not Test
NFSR #8 vs. NFSR #2	48.661	5	2.176	0.537	Do Not Test
NFSR #8 vs. NFSR #4	32.050	4	1.433	0.742	Do Not Test
NFSR #8 vs. NFSR #6	22.735	3	1.017	0.752	Do Not Test
NFSR #8 vs. NFSR #3	22.225	2	0.994	0.482	Do Not Test
NFSR #3 vs. NFSR #7	116.721	9	5.220	0.007	Yes
NFSR #3 vs. NFSR #1	80.569	8	3.603	0.176	No
NFSR #3 vs. Horse Ck #1	52.012	7	2.326	0.653	Do Not Test
NFSR #3 vs. Cedar Ck #1	42.413	6	1.897	0.762	Do Not Test
NFSR #3 vs. NFSR #9	39.901	5	1.784	0.715	Do Not Test
NFSR #3 vs. NFSR #2	26.436	4	1.182	0.837	Do Not Test
NFSR #3 vs. NFSR #4	9.825	3	0.439	0.948	Do Not Test
NFSR #3 vs. NFSR #6	0.510	2	0.0228	0.987	Do Not Test
NFSR #6 vs. NFSR #7	116.211	8	5.197	0.006	Yes
NFSR #6 vs. NFSR #1	80.059	7	3.580	0.148	Do Not Test
NFSR #6 vs. Horse Ck #1	51.502	6	2.303	0.579	Do Not Test
NFSR #6 vs. Cedar Ck #1	41.903	5	1.874	0.676	Do Not Test
NFSR #6 vs. NFSR #9	39.390	4	1.762	0.598	Do Not Test
NFSR #6 vs. NFSR #2	25.926	3	1.159	0.691	Do Not Test
NFSR #6 vs. NFSR #4	9.314	2	0.417	0.768	Do Not Test

NFSR #4 vs. NFSR #7	106.896	7	4.780	0.013	Yes
NFSR #4 vs. NFSR #1	70.744	6	3.164	0.221	Do Not Test
NFSR #4 vs. Horse Ck #1	42.188	5	1.887	0.670	Do Not Test
NFSR #4 vs. Cedar Ck #1	32.589	4	1.457	0.732	Do Not Test
NFSR #4 vs. NFSR #9	30.076	3	1.345	0.608	Do Not Test
NFSR #4 vs. NFSR #2	16.611	2	0.743	0.599	Do Not Test
NFSR #2 vs. NFSR #7	90.285	6	4.038	0.049	Yes
NFSR #2 vs. NFSR #1	54.133	5	2.421	0.427	Do Not Test
NFSR #2 vs. Horse Ck #1	25.576	4	1.144	0.850	Do Not Test
NFSR #2 vs. Cedar Ck #1	15.977	3	0.714	0.869	Do Not Test
NFSR #2 vs. NFSR #9	13.465	2	0.602	0.670	Do Not Test
NFSR #9 vs. NFSR #7	76.820	5	3.435	0.108	No
NFSR #9 vs. NFSR #1	40.669	4	1.819	0.572	Do Not Test
NFSR #9 vs. Horse Ck #1	12.112	3	0.542	0.922	Do Not Test
NFSR #9 vs. Cedar Ck #1	2.513	2	0.112	0.937	Do Not Test
Cedar Ck #1 vs. NFSR #7	74.308	4	3.323	0.087	Do Not Test
Cedar Ck #1 vs. NFSR #1	38.156	3	1.706	0.449	Do Not Test
Cedar Ck #1 vs. Horse Ck #1	9.599	2	0.429	0.761	Do Not Test
Horse Ck #1 vs. NFSR #7	64.708	3	2.894	0.101	Do Not Test
Horse Ck #1 vs. NFSR #1	28.557	2	1.277	0.367	Do Not Test
NFSR #1 vs. NFSR #7	36.152	2	1.617	0.253	Do Not Test

A result of "Do Not Test" occurs for a comparison when no significant difference is found between two means that enclose that comparison. For example, if you had four means sorted in order, and found no difference between means 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed means is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the means, even though one may appear to exist.

One Way Analysis of Variance Tuesday, February 19, 2008, 2:21:05 PM

Data source: Benthic Sediment

Dependent Variable: Sand

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way Analysis of Variance on Ranks Tuesday, February 19, 2008, 2:21:05 PM

Data source: Data 1 in Benthic Sediment

Group	N	Missing	Median	25%	75%
NFSR #1	10	0	0.000	0.000	3135.150
NFSR #2	10	0	7837.875	0.000	14630.700
NFSR #3	10	0	31874.025	20901.000	36576.750
NFSR #4	10	0	20901.000	14630.700	22991.100
NFSR #5	10	0	25081.200	21946.050	29261.400
NFSR #6	10	0	16198.275	13585.650	19855.950
NFSR #7	10	0	6270.300	0.000	10450.500
NFSR #8	10	0	13063.125	6270.300	15675.750
NFSR #9	10	0	4180.200	0.000	6270.300
NFSR #10	10	0	13063.125	4180.200	26126.250
Horse Ck #1	10	0	30828.975	17765.850	37621.800
Cedar Ck #1	10	0	6270.300	5225.250	17765.850
LDC #1	10	0	19855.950	15675.750	29261.400
LDC #2	10	0	41279.475	35531.700	65838.150

H = 72.697 with 13 degrees of freedom. (P = <0.001)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise Multiple Comparison Procedures (Student-Newman-Keuls Method):

Comparison	Diff of Ranks	q	P<0.05
LDC #2 vs NFSR #1	990.500	7.723	Yes
LDC #2 vs NFSR #7	868.000	7.286	Yes
LDC #2 vs NFSR #9	774.000	7.036	Yes
LDC #2 vs NFSR #2	700.500	6.944	Yes
LDC #2 vs Cedar Ck #1	681.000	7.423	Yes
LDC #2 vs NFSR #8	626.000	7.577	Yes
LDC #2 vs NFSR #10	546.500	7.437	Yes
LDC #2 vs NFSR #6	487.000	7.567	Yes
LDC #2 vs NFSR #4	354.500	6.419	Yes
LDC #2 vs LDC #1	315.500	6.844	Yes
LDC #2 vs NFSR #5	176.500	4.774	Yes
LDC #2 vs Horse Ck #1	154.500	5.550	Yes
LDC #2 vs NFSR #3	150.500	8.045	Yes

NFSR #3 vs NFSR #1	840.000	7.051	Yes
NFSR #3 vs NFSR #7	717.500	6.523	Yes
NFSR #3 vs NFSR #9	623.500	6.181	Yes
NFSR #3 vs NFSR #2	550.000	5.995	Yes
NFSR #3 vs Cedar Ck #1	530.500	6.421	Yes
NFSR #3 vs NFSR #8	475.500	6.471	Yes
NFSR #3 vs NFSR #10	396.000	6.153	Yes
NFSR #3 vs NFSR #6	336.500	6.093	Yes
NFSR #3 vs NFSR #4	204.000	4.425	Yes
NFSR #3 vs LDC #1	165.000	4.463	Yes
NFSR #3 vs NFSR #5	26.000	0.934	No
NFSR #3 vs Horse Ck #1	4.000	0.214	Do Not Test
Horse Ck #1 vs NFSR #1	836.000	7.600	Yes
Horse Ck #1 vs NFSR #7	713.500	7.073	Yes
Horse Ck #1 vs NFSR #9	619.500	6.753	Yes
Horse Ck #1 vs NFSR #2	546.000	6.609	Yes
Horse Ck #1 vs Cedar Ck #1	526.500	7.165	Yes
Horse Ck #1 vs NFSR #8	471.500	7.326	Yes
Horse Ck #1 vs NFSR #10	392.000	7.098	Yes
Horse Ck #1 vs NFSR #6	332.500	7.213	Yes
Horse Ck #1 vs NFSR #4	200.000	5.410	Yes
Horse Ck #1 vs LDC #1	161.000	5.783	Yes
Horse Ck #1 vs NFSR #5	22.000	1.176	Do Not Test
NFSR #5 vs NFSR #1	814.000	8.070	Yes
NFSR #5 vs NFSR #7	691.500	7.537	Yes
NFSR #5 vs NFSR #9	597.500	7.232	Yes
NFSR #5 vs NFSR #2	524.000	7.131	Yes
NFSR #5 vs Cedar Ck #1	504.500	7.839	Yes
NFSR #5 vs NFSR #8	449.500	8.139	Yes
NFSR #5 vs NFSR #10	370.000	8.026	Yes
NFSR #5 vs NFSR #6	310.500	8.399	Yes
NFSR #5 vs NFSR #4	178.000	6.394	Yes
NFSR #5 vs LDC #1	139.000	7.430	Yes
LDC #1 vs NFSR #1	675.000	7.358	Yes
LDC #1 vs NFSR #7	552.500	6.688	Yes
LDC #1 vs NFSR #9	458.500	6.239	Yes
LDC #1 vs NFSR #2	385.000	5.982	Yes
LDC #1 vs Cedar Ck #1	365.500	6.618	Yes
LDC #1 vs NFSR #8	310.500	6.736	Yes
LDC #1 vs NFSR #10	231.000	6.249	Yes
LDC #1 vs NFSR #6	171.500	6.160	Yes
LDC #1 vs NFSR #4	39.000	2.085	No
NFSR #4 vs NFSR #1	636.000	7.698	Yes
NFSR #4 vs NFSR #7	513.500	6.988	Yes
NFSR #4 vs NFSR #9	419.500	6.518	Yes
NFSR #4 vs NFSR #2	346.000	6.265	Yes
NFSR #4 vs Cedar Ck #1	326.500	7.083	Yes
NFSR #4 vs NFSR #8	271.500	7.344	Yes
NFSR #4 vs NFSR #10	192.000	6.897	Yes
NFSR #4 vs NFSR #6	132.500	7.082	Yes
NFSR #6 vs NFSR #1	503.500	6.852	Yes
NFSR #6 vs NFSR #7	381.000	5.920	Yes
NFSR #6 vs NFSR #9	287.000	5.197	Yes
NFSR #6 vs NFSR #2	213.500	4.631	Yes
NFSR #6 vs Cedar Ck #1	194.000	5.248	Yes
NFSR #6 vs NFSR #8	139.000	4.993	Yes

NFSR #6 vs NFSR #10	59.500	3.180	Yes
NFSR #10 vs NFSR #1	444.000	6.899	Yes
NFSR #10 vs NFSR #7	321.500	5.821	Yes
NFSR #10 vs NFSR #9	227.500	4.935	Yes
NFSR #10 vs NFSR #2	154.000	4.166	Yes
NFSR #10 vs Cedar Ck #1	134.500	4.831	Yes
NFSR #10 vs NFSR #8	79.500	4.249	Yes
NFSR #8 vs NFSR #1	364.500	6.600	Yes
NFSR #8 vs NFSR #7	242.000	5.250	Yes
NFSR #8 vs NFSR #9	148.000	4.003	Yes
NFSR #8 vs NFSR #2	74.500	2.676	No
NFSR #8 vs Cedar Ck #1	55.000	2.940	Do Not Test
Cedar Ck #1 vs NFSR #1	309.500	6.714	Yes
Cedar Ck #1 vs NFSR #7	187.000	5.058	Yes
Cedar Ck #1 vs NFSR #9	93.000	3.341	Yes
Cedar Ck #1 vs NFSR #2	19.500	1.042	Do Not Test
NFSR #2 vs NFSR #1	290.000	7.845	Yes
NFSR #2 vs NFSR #7	167.500	6.017	Yes
NFSR #2 vs NFSR #9	73.500	3.929	Yes
NFSR #9 vs NFSR #1	216.500	7.777	Yes
NFSR #9 vs NFSR #7	94.000	5.025	Yes
NFSR #7 vs NFSR #1	122.500	6.548	Yes

Note: The multiple comparisons on ranks do not include an adjustment for ties.

A result of "Do Not Test" occurs for a comparison when no significant difference is found between the two rank sums that enclose that comparison. For example, if you had four rank sums sorted in order, and found no significant difference between rank sums 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed rank sums is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the rank sums, even though one may appear to exist.

Appendix F

Statistical Analyses Comparing Channel Measurements Collected at the Sampling Stations. Kruskal-Wallis ANOVA on Ranks and Student-Newman-Keuls Multiple Comparison Test Were Used to Test Differences in Channel Width, Wetted Width, Channel Width to Wetted Width Ratio, and Water Depth. One-Way ANOVA, Log_{10} Transformed, and Student-Newman-Keuls Multiple Comparison Test Were Used to Test Differences in Wetted Width to Water Depth Ratio.

One Way Analysis of Variance Tuesday, February 19, 2008, 2:29:47 PM

Data source: Channel Measurements

Dependent Variable: Channel Width

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way Analysis of Variance on Ranks Tuesday, February 19, 2008, 2:29:47 PM

Data source: Data 1 in Channel Measurements

Group	N	Missing	Median	25%	75%
NFSR #1	10	0	83.000	80.000	91.000
NFSR #2	10	0	72.500	67.800	76.000
NFSR #3	10	0	53.500	45.000	55.000
NFSR #4	10	0	46.000	42.000	51.000
NFSR #5	10	0	47.250	45.000	49.000
NFSR #6	10	0	51.000	41.000	64.000
NFSR #7	10	0	62.000	60.000	69.000
NFSR #8	10	0	71.000	69.000	77.000
NFSR #9	10	0	66.000	64.000	69.000
NFSR #10	10	0	53.500	47.000	62.000
Horse Creek #1	10	0	61.000	54.000	71.000
Cedar Creek #1	10	0	93.250	58.400	123.000
LDC #1	10	0	43.000	40.000	53.000
LDC #2	10	0	33.100	33.000	38.000

H = 96.501 with 13 degrees of freedom. (P = <0.001)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise Multiple Comparison Procedures (Student-Newman-Keuls Method):

Comparison	Diff of Ranks	q	P<0.05
NFSR #1 vs LDC #2	1130.000	8.810	Yes
NFSR #1 vs NFSR #4	922.000	7.740	Yes
NFSR #1 vs NFSR #5	918.500	8.350	Yes
NFSR #1 vs LDC #1	894.000	8.863	Yes
NFSR #1 vs NFSR #6	779.000	8.491	Yes
NFSR #1 vs NFSR #3	763.500	9.242	Yes
NFSR #1 vs NFSR #10	752.500	10.240	Yes
NFSR #1 vs Horse Creek #1	433.000	6.728	Yes
NFSR #1 vs NFSR #7	419.000	7.587	Yes
NFSR #1 vs NFSR #9	381.000	8.265	Yes
NFSR #1 vs NFSR #8	235.500	6.370	Yes
NFSR #1 vs NFSR #2	189.500	6.807	Yes
NFSR #1 vs Cedar Creek #1	183.500	9.808	Yes

Cedar Creek #1 vs LDC #2	946.500	7.945	Yes
Cedar Creek #1 vs NFSR #4	738.500	6.714	Yes
Cedar Creek #1 vs NFSR #5	735.000	7.287	Yes
Cedar Creek #1 vs LDC #1	710.500	7.745	Yes
Cedar Creek #1 vs NFSR #6	595.500	7.208	Yes
Cedar Creek #1 vs NFSR #3	580.000	7.893	Yes
Cedar Creek #1 vs NFSR #10	569.000	8.841	Yes
Cedar Creek # vs Horse Creek #	249.500	4.518	Yes
Cedar Creek #1 vs NFSR #7	235.500	5.109	Yes
Cedar Creek #1 vs NFSR #9	197.500	5.342	Yes
Cedar Creek #1 vs NFSR #8	52.000	1.868	No
Cedar Creek #1 vs NFSR #2	6.000	0.321	Do Not Test
NFSR #2 vs LDC #2	940.500	8.550	Yes
NFSR #2 vs NFSR #4	732.500	7.262	Yes
NFSR #2 vs NFSR #5	729.000	7.946	Yes
NFSR #2 vs LDC #1	704.500	8.528	Yes
NFSR #2 vs NFSR #6	589.500	8.022	Yes
NFSR #2 vs NFSR #3	574.000	8.919	Yes
NFSR #2 vs NFSR #10	563.000	10.194	Yes
NFSR #2 vs Horse Creek #1	243.500	5.282	Yes
NFSR #2 vs NFSR #7	229.500	6.208	Yes
NFSR #2 vs NFSR #9	191.500	6.879	Yes
NFSR #2 vs NFSR #8	46.000	2.459	Do Not Test
NFSR #8 vs LDC #2	894.500	8.868	Yes
NFSR #8 vs NFSR #4	686.500	7.483	Yes
NFSR #8 vs NFSR #5	683.000	8.267	Yes
NFSR #8 vs LDC #1	658.500	8.961	Yes
NFSR #8 vs NFSR #6	543.500	8.445	Yes
NFSR #8 vs NFSR #3	528.000	9.561	Yes
NFSR #8 vs NFSR #10	517.000	11.215	Yes
NFSR #8 vs Horse Creek #1	197.500	5.342	Yes
NFSR #8 vs NFSR #7	183.500	6.592	Yes
NFSR #8 vs NFSR #9	145.500	7.777	Yes
NFSR #9 vs LDC #2	749.000	8.164	Yes
NFSR #9 vs NFSR #4	541.000	6.549	Yes
NFSR #9 vs NFSR #5	537.500	7.314	Yes
NFSR #9 vs LDC #1	513.000	7.971	Yes
NFSR #9 vs NFSR #6	398.000	7.207	Yes
NFSR #9 vs NFSR #3	382.500	8.298	Yes
NFSR #9 vs NFSR #10	371.500	10.049	Yes
NFSR #9 vs Horse Creek #1	52.000	1.868	No
NFSR #9 vs NFSR #7	38.000	2.031	Do Not Test
NFSR #7 vs LDC #2	711.000	8.606	Yes
NFSR #7 vs NFSR #4	503.000	6.845	Yes
NFSR #7 vs NFSR #5	499.500	7.762	Yes
NFSR #7 vs LDC #1	475.000	8.601	Yes
NFSR #7 vs NFSR #6	360.000	7.809	Yes
NFSR #7 vs NFSR #3	344.500	9.319	Yes
NFSR #7 vs NFSR #10	333.500	11.980	Yes
NFSR #7 vs Horse Creek #1	14.000	0.748	Do Not Test
Horse Creek #1 vs LDC #2	697.000	9.485	Yes
Horse Creek #1 vs NFSR #4	489.000	7.598	Yes
Horse Creek #1 vs NFSR #5	485.500	8.791	Yes
Horse Creek #1 vs LDC #1	461.000	10.000	Yes
Horse Creek #1 vs NFSR #6	346.000	9.359	Yes
Horse Creek #1 vs NFSR #3	330.500	11.872	Yes

Horse Creek #1 vs NFSR #10	319.500	17.078	Yes
NFSR #10 vs LDC #2	377.500	5.866	Yes
NFSR #10 vs NFSR #4	169.500	3.069	No
NFSR #10 vs NFSR #5	166.000	3.601	Do Not Test
NFSR #10 vs LDC #1	141.500	3.828	Do Not Test
NFSR #10 vs NFSR #6	26.500	0.952	Do Not Test
NFSR #10 vs NFSR #3	11.000	0.588	Do Not Test
NFSR #3 vs LDC #2	366.500	6.636	Yes
NFSR #3 vs NFSR #4	158.500	3.438	Do Not Test
NFSR #3 vs NFSR #5	155.000	4.193	Do Not Test
NFSR #3 vs LDC #1	130.500	4.688	Do Not Test
NFSR #3 vs NFSR #6	15.500	0.829	Do Not Test
NFSR #6 vs LDC #2	351.000	7.614	Yes
NFSR #6 vs NFSR #4	143.000	3.868	Do Not Test
NFSR #6 vs NFSR #5	139.500	5.011	Do Not Test
NFSR #6 vs LDC #1	115.000	6.147	Do Not Test
LDC #1 vs LDC #2	236.000	6.384	Yes
LDC #1 vs NFSR #4	28.000	1.006	Do Not Test
LDC #1 vs NFSR #5	24.500	1.310	Do Not Test
NFSR #5 vs LDC #2	211.500	7.597	Yes
NFSR #5 vs NFSR #4	3.500	0.187	Do Not Test
NFSR #4 vs LDC #2	208.000	11.118	Yes

Note: The multiple comparisons on ranks do not include an adjustment for ties.

A result of "Do Not Test" occurs for a comparison when no significant difference is found between the two rank sums that enclose that comparison. For example, if you had four rank sums sorted in order, and found no significant difference between rank sums 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed rank sums is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the rank sums, even though one may appear to exist.

One Way Analysis of Variance Tuesday, February 19, 2008, 2:34:20 PM

Data source: Channel Measurements

Dependent Variable: Wetted Width

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way Analysis of Variance on Ranks Tuesday, February 19, 2008, 2:34:20 PM

Data source: Data 1 in Channel Measurements

Group	**N**	**Missing**	**Median**	**25%**	**75%**
NFSR #1	10	0	61.500	44.500	68.500
NFSR #2	10	0	42.000	29.000	50.000
NFSR #3	10	0	33.000	31.000	35.200
NFSR #4	10	0	38.000	34.000	39.500
NFSR #5	10	0	36.900	34.000	38.900
NFSR #6	10	0	16.000	10.500	20.000
NFSR #7	10	0	24.000	19.500	40.000
NFSR #8	10	0	51.500	26.000	62.000
NFSR #9	10	0	33.500	19.500	55.000
NFSR #10	10	0	27.750	18.000	41.000
Horse Creek #1	10	0	23.400	20.500	27.000
Cedar Creek #1	10	0	35.250	27.000	42.000
LDC #1	10	0	23.250	17.800	26.000
LDC #2	10	0	16.000	11.900	20.300

H = 61.521 with 13 degrees of freedom. (P = <0.001)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise Multiple Comparison Procedures (Student-Newman-Keuls Method):

Comparison	**Diff of Ranks**	**q**	**P<0.05**
NFSR #1 vs LDC #2	911.000	7.103	Yes
NFSR #1 vs NFSR #6	897.500	7.534	Yes
NFSR #1 vs LDC #1	730.000	6.636	Yes
NFSR #1 vs Horse Creek #1	604.500	5.993	Yes
NFSR #1 vs NFSR #7	525.500	5.728	Yes
NFSR #1 vs NFSR #10	480.500	5.816	Yes
NFSR #1 vs NFSR #9	360.500	4.906	Yes
NFSR #1 vs NFSR #3	311.500	4.840	Yes
NFSR #1 vs Cedar Creek #1	310.000	5.613	Yes
NFSR #1 vs NFSR #5	254.500	5.521	Yes
NFSR #1 vs NFSR #4	221.000	5.978	Yes
NFSR #1 vs NFSR #8	180.500	6.484	Yes
NFSR #1 vs NFSR #2	156.000	8.339	Yes

NFSR #2 vs LDC #2	755.000	6.338	Yes
NFSR #2 vs NFSR #6	741.500	6.741	Yes
NFSR #2 vs LDC #1	574.000	5.690	Yes
NFSR #2 vs Horse Creek #1	448.500	4.889	Yes
NFSR #2 vs NFSR #7	369.500	4.473	Yes
NFSR #2 vs NFSR #10	324.500	4.416	Yes
NFSR #2 vs NFSR #9	204.500	3.178	No
NFSR #2 vs NFSR #3	155.500	2.816	Do Not Test
NFSR #2 vs Cedar Creek #1	154.000	3.341	Do Not Test
NFSR #2 vs NFSR #5	98.500	2.664	Do Not Test
NFSR #2 vs NFSR #4	65.000	2.335	Do Not Test
NFSR #2 vs NFSR #8	24.500	1.310	Do Not Test
NFSR #8 vs LDC #2	730.500	6.641	Yes
NFSR #8 vs NFSR #6	717.000	7.108	Yes
NFSR #8 vs LDC #1	549.500	5.990	Yes
NFSR #8 vs Horse Creek #1	424.000	5.132	Yes
NFSR #8 vs NFSR #7	345.000	4.695	Yes
NFSR #8 vs NFSR #10	300.000	4.662	Yes
NFSR #8 vs NFSR #9	180.000	3.259	Do Not Test
NFSR #8 vs NFSR #3	131.000	2.842	Do Not Test
NFSR #8 vs Cedar Creek #1	129.500	3.503	Do Not Test
NFSR #8 vs NFSR #5	74.000	2.658	Do Not Test
NFSR #8 vs NFSR #4	40.500	2.165	Do Not Test
NFSR #4 vs LDC #2	690.000	6.840	Yes
NFSR #4 vs NFSR #6	676.500	7.374	Yes
NFSR #4 vs LDC #1	509.000	6.161	Yes
NFSR #4 vs Horse Creek #1	383.500	5.219	Yes
NFSR #4 vs NFSR #7	304.500	4.732	Yes
NFSR #4 vs NFSR #10	259.500	4.699	Yes
NFSR #4 vs NFSR #9	139.500	3.026	Do Not Test
NFSR #4 vs NFSR #3	90.500	2.448	Do Not Test
NFSR #4 vs Cedar Creek #1	89.000	3.197	Do Not Test
NFSR #4 vs NFSR #5	33.500	1.791	Do Not Test
NFSR #5 vs LDC #2	656.500	7.156	Yes
NFSR #5 vs NFSR #6	643.000	7.783	Yes
NFSR #5 vs LDC #1	475.500	6.471	Yes
NFSR #5 vs Horse Creek #1	350.000	5.439	Yes
NFSR #5 vs NFSR #7	271.000	4.907	Yes
NFSR #5 vs NFSR #10	226.000	4.903	Yes
NFSR #5 vs NFSR #9	106.000	2.867	Do Not Test
NFSR #5 vs NFSR #3	57.000	2.048	Do Not Test
NFSR #5 vs Cedar Creek #1	55.500	2.967	Do Not Test
Cedar Creek #1 vs LDC #2	601.000	7.275	Yes
Cedar Creek #1 vs NFSR #6	587.500	7.995	Yes
Cedar Creek #1 vs LDC #1	420.000	6.526	Yes
Cedar Creek # vs Horse Creek #	294.500	5.333	Yes
Cedar Creek #1 vs NFSR #7	215.500	4.675	Yes
Cedar Creek #1 vs NFSR #10	170.500	4.612	Yes
Cedar Creek #1 vs NFSR #9	50.500	1.814	Do Not Test
Cedar Creek #1 vs NFSR #3	1.500	0.0802	Do Not Test
NFSR #3 vs LDC #2	599.500	8.158	Yes
NFSR #3 vs NFSR #6	586.000	9.106	Yes
NFSR #3 vs LDC #1	418.500	7.578	Yes
NFSR #3 vs Horse Creek #1	293.000	6.356	Yes
NFSR #3 vs NFSR #7	214.000	5.789	Yes
NFSR #3 vs NFSR #10	169.000	6.071	Yes

NFSR #3 vs NFSR #9	49.000	2.619	Do Not Test
NFSR #9 vs LDC #2	550.500	8.554	Yes
NFSR #9 vs NFSR #6	537.000	9.724	Yes
NFSR #9 vs LDC #1	369.500	8.016	Yes
NFSR #9 vs Horse Creek #1	244.000	6.600	Yes
NFSR #9 vs NFSR #7	165.000	5.927	Yes
NFSR #9 vs NFSR #10	120.000	6.414	Yes
NFSR #10 vs LDC #2	430.500	7.795	Yes
NFSR #10 vs NFSR #6	417.000	9.046	Yes
NFSR #10 vs LDC #1	249.500	6.749	Yes
NFSR #10 vs Horse Creek #1	124.000	4.454	Yes
NFSR #10 vs NFSR #7	45.000	2.405	No
NFSR #7 vs LDC #2	385.500	8.363	Yes
NFSR #7 vs NFSR #6	372.000	10.063	Yes
NFSR #7 vs LDC #1	204.500	7.346	Yes
NFSR #7 vs Horse Creek #1	79.000	4.223	Yes
Horse Creek #1 vs LDC #2	306.500	8.291	Yes
Horse Creek #1 vs NFSR #6	293.000	10.525	Yes
Horse Creek #1 vs LDC #1	125.500	6.708	Yes
LDC #1 vs LDC #2	181.000	6.502	Yes
LDC #1 vs NFSR #6	167.500	8.953	Yes
NFSR #6 vs LDC #2	13.500	0.722	No

Note: The multiple comparisons on ranks do not include an adjustment for ties.

A result of "Do Not Test" occurs for a comparison when no significant difference is found between the two rank sums that enclose that comparison. For example, if you had four rank sums sorted in order, and found no significant difference between rank sums 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed rank sums is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the rank sums, even though one may appear to exist.

One Way Analysis of Variance Tuesday, February 19, 2008, 2:38:18 PM

Data source: Channel Measurements

Dependent Variable: Channel Width to Wetted Width Ratio

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way Analysis of Variance on Ranks Tuesday, February 19, 2008, 2:38:18 PM

Data source: Data 1 in Channel Measurements

Group	**N**	**Missing**	**Median**	**25%**	**75%**
NFSR #1	10	0	1.334	1.186	1.820
NFSR #2	10	0	1.615	1.402	2.552
NFSR #3	10	0	1.575	1.286	1.667
NFSR #4	10	0	1.227	1.165	1.394
NFSR #5	10	0	1.255	1.162	1.453
NFSR #6	10	0	3.237	2.412	4.800
NFSR #7	10	0	2.475	1.525	3.268
NFSR #8	10	0	1.325	1.131	3.115
NFSR #9	10	0	1.809	1.160	3.744
NFSR #10	10	0	1.914	1.378	2.423
Horse Creek #1	10	0	2.445	2.077	2.940
Cedar Creek #1	10	0	2.683	1.452	4.214
LDC #1	10	0	2.060	1.615	2.933
LDC #2	10	0	2.015	1.790	2.696

H = 46.128 with 13 degrees of freedom. (P = <0.001)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise Multiple Comparison Procedures (Student-Newman-Keuls Method):

Comparison	**Diff of Ranks**	**q**	**P<0.05**
NFSR #6 vs NFSR #4	829.000	6.464	Yes
NFSR #6 vs NFSR #5	763.500	6.409	Yes
NFSR #6 vs NFSR #3	582.000	5.291	Yes
NFSR #6 vs NFSR #1	563.500	5.586	Yes
NFSR #6 vs NFSR #8	535.000	5.832	Yes
NFSR #6 vs NFSR #9	435.500	5.272	Yes
NFSR #6 vs NFSR #2	410.500	5.586	Yes
NFSR #6 vs NFSR #10	386.500	6.006	Yes
NFSR #6 vs LDC #1	247.500	4.482	Yes
NFSR #6 vs LDC #2	212.500	4.610	Yes
NFSR #6 vs Cedar Creek #1	208.500	5.640	Yes
NFSR #6 vs NFSR #7	181.500	6.520	Yes
NFSR #6 vs Horse Creek #1	153.500	8.205	Yes

Horse Creek #1 vs NFSR #4	675.500	5.670	Yes
Horse Creek #1 vs NFSR #5	610.000	5.545	Yes
Horse Creek #1 vs NFSR #3	428.500	4.248	No
Horse Creek #1 vs NFSR #1	410.000	4.469	Do Not Test
Horse Creek #1 vs NFSR #8	381.500	4.618	Do Not Test
Horse Creek #1 vs NFSR #9	282.000	3.838	Do Not Test
Horse Creek #1 vs NFSR #2	257.000	3.993	Do Not Test
Horse Creek #1 vs NFSR #10	233.000	4.219	Do Not Test
Horse Creek #1 vs LDC #1	94.000	2.039	Do Not Test
Horse Creek #1 vs LDC #2	59.000	1.596	Do Not Test
Horse Creek # vs Cedar Creek #	55.000	1.976	Do Not Test
Horse Creek #1 vs NFSR #7	28.000	1.497	Do Not Test
NFSR #7 vs NFSR #4	647.500	5.886	Yes
NFSR #7 vs NFSR #5	582.000	5.770	Yes
NFSR #7 vs NFSR #3	400.500	4.365	Do Not Test
NFSR #7 vs NFSR #1	382.000	4.624	Do Not Test
NFSR #7 vs NFSR #8	353.500	4.811	Do Not Test
NFSR #7 vs NFSR #9	254.000	3.947	Do Not Test
NFSR #7 vs NFSR #2	229.000	4.147	Do Not Test
NFSR #7 vs NFSR #10	205.000	4.447	Do Not Test
NFSR #7 vs LDC #1	66.000	1.785	Do Not Test
NFSR #7 vs LDC #2	31.000	1.114	Do Not Test
NFSR #7 vs Cedar Creek #1	27.000	1.443	Do Not Test
Cedar Creek #1 vs NFSR #4	620.500	6.151	Yes
Cedar Creek #1 vs NFSR #5	555.000	6.050	Yes
Cedar Creek #1 vs NFSR #3	373.500	4.521	Do Not Test
Cedar Creek #1 vs NFSR #1	355.000	4.831	Do Not Test
Cedar Creek #1 vs NFSR #8	326.500	5.073	Do Not Test
Cedar Creek #1 vs NFSR #9	227.000	4.110	Do Not Test
Cedar Creek #1 vs NFSR #2	202.000	4.382	Do Not Test
Cedar Creek #1 vs NFSR #10	178.000	4.815	Do Not Test
Cedar Creek #1 vs LDC #1	39.000	1.401	Do Not Test
Cedar Creek #1 vs LDC #2	4.000	0.214	Do Not Test
LDC #2 vs NFSR #4	616.500	6.720	Yes
LDC #2 vs NFSR #5	551.000	6.670	Yes
LDC #2 vs NFSR #3	369.500	5.028	Do Not Test
LDC #2 vs NFSR #1	351.000	5.454	Do Not Test
LDC #2 vs NFSR #8	322.500	5.840	Do Not Test
LDC #2 vs NFSR #9	223.000	4.838	Do Not Test
LDC #2 vs NFSR #2	198.000	5.356	Do Not Test
LDC #2 vs NFSR #10	174.000	6.250	Do Not Test
LDC #2 vs LDC #1	35.000	1.871	Do Not Test
LDC #1 vs NFSR #4	581.500	7.039	Yes
LDC #1 vs NFSR #5	516.000	7.022	Yes
LDC #1 vs NFSR #3	334.500	5.198	Do Not Test
LDC #1 vs NFSR #1	316.000	5.722	Do Not Test
LDC #1 vs NFSR #8	287.500	6.237	Do Not Test
LDC #1 vs NFSR #9	188.000	5.085	Do Not Test
LDC #1 vs NFSR #2	163.000	5.855	Do Not Test
LDC #1 vs NFSR #10	139.000	7.430	Do Not Test
NFSR #10 vs NFSR #4	442.500	6.022	Yes
NFSR #10 vs NFSR #5	377.000	5.858	Yes
NFSR #10 vs NFSR #3	195.500	3.540	Do Not Test
NFSR #10 vs NFSR #1	177.000	3.840	Do Not Test
NFSR #10 vs NFSR #8	148.500	4.017	Do Not Test
NFSR #10 vs NFSR #9	49.000	1.760	Do Not Test

NFSR #10 vs NFSR #2	24.000	1.283	Do Not Test
NFSR #2 vs NFSR #4	418.500	6.503	Yes
NFSR #2 vs NFSR #5	353.000	6.392	Yes
NFSR #2 vs NFSR #3	171.500	3.720	Do Not Test
NFSR #2 vs NFSR #1	153.000	4.139	Do Not Test
NFSR #2 vs NFSR #8	124.500	4.472	Do Not Test
NFSR #2 vs NFSR #9	25.000	1.336	Do Not Test
NFSR #9 vs NFSR #4	393.500	7.125	Yes
NFSR #9 vs NFSR #5	328.000	7.115	Yes
NFSR #9 vs NFSR #3	146.500	3.963	Do Not Test
NFSR #9 vs NFSR #1	128.000	4.598	Do Not Test
NFSR #9 vs NFSR #8	99.500	5.318	Do Not Test
NFSR #8 vs NFSR #4	294.000	6.378	Yes
NFSR #8 vs NFSR #5	228.500	6.181	Yes
NFSR #8 vs NFSR #3	47.000	1.688	Do Not Test
NFSR #8 vs NFSR #1	28.500	1.523	Do Not Test
NFSR #1 vs NFSR #4	265.500	7.182	Yes
NFSR #1 vs NFSR #5	200.000	7.184	Yes
NFSR #1 vs NFSR #3	18.500	0.989	Do Not Test
NFSR #3 vs NFSR #4	247.000	8.873	Yes
NFSR #3 vs NFSR #5	181.500	9.702	Yes
NFSR #5 vs NFSR #4	65.500	3.501	Yes

Note: The multiple comparisons on ranks do not include an adjustment for ties.

A result of "Do Not Test" occurs for a comparison when no significant difference is found between the two rank sums that enclose that comparison. For example, if you had four rank sums sorted in order, and found no significant difference between rank sums 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed rank sums is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the rank sums, even though one may appear to exist.

One Way Analysis of Variance Tuesday, February 19, 2008, 2:44:34 PM

Data source: Channel Measurements

Dependent Variable: Water Depth

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way Analysis of Variance on Ranks Tuesday, February 19, 2008, 2:44:34 PM

Data source: Data 2 in Channel Measurements

Group	**N**	**Missing**	**Median**	**25%**	**75%**
NFSR #1	30	0	0.800	0.600	1.500
NFSR #2	30	0	1.125	0.550	2.450
NFSR #3	30	0	2.350	1.700	2.500
NFSR #4	30	0	2.300	1.550	2.800
NFSR #5	30	0	2.050	1.800	2.500
NFSR #6	30	0	0.900	0.650	1.500
NFSR #7	30	0	0.850	0.650	1.500
NFSR #8	30	0	1.325	0.700	2.200
NFSR #9	30	0	0.950	0.650	1.500
NFSR #10	30	0	1.025	0.500	1.500
Horse Creek #1	30	0	0.875	0.650	1.300
Cedar Creek #1	30	0	0.950	0.600	1.450
LDC #1	30	0	1.100	0.600	1.350
LDC #2	30	0	0.785	0.600	0.950

H = 118.244 with 13 degrees of freedom. (P = <0.001)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise Multiple Comparison Procedures (Student-Newman-Keuls Method):

Comparison	**Diff of Ranks**	**q**	**P<0.05**
NFSR #4 vs LDC #2	5991.000	9.011	Yes
NFSR #4 vs NFSR #1	5250.500	8.504	Yes
NFSR #4 vs Horse Creek #1	5149.000	9.033	Yes
NFSR #4 vs Cedar Creek #1	5100.500	9.760	Yes
NFSR #4 vs NFSR #7	5041.000	10.610	Yes
NFSR #4 vs NFSR #10	4731.000	11.062	Yes
NFSR #4 vs LDC #1	4727.000	12.431	Yes
NFSR #4 vs NFSR #9	4600.500	13.822	Yes
NFSR #4 vs NFSR #6	4559.000	15.974	Yes
NFSR #4 vs NFSR #2	3740.500	15.719	Yes
NFSR #4 vs NFSR #8	3253.000	17.074	Yes
NFSR #4 vs NFSR #5	534.500	3.735	Yes
NFSR #4 vs NFSR #3	347.500	3.633	Yes

NFSR #3 vs LDC #2	5643.500	9.140	Yes
NFSR #3 vs NFSR #1	4903.000	8.602	Yes
NFSR #3 vs Horse Creek #1	4801.500	9.188	Yes
NFSR #3 vs Cedar Creek #1	4753.000	10.004	Yes
NFSR #3 vs NFSR #7	4693.500	10.974	Yes
NFSR #3 vs NFSR #10	4383.500	11.528	Yes
NFSR #3 vs LDC #1	4379.500	13.158	Yes
NFSR #3 vs NFSR #9	4253.000	14.902	Yes
NFSR #3 vs NFSR #6	4211.500	17.698	Yes
NFSR #3 vs NFSR #2	3393.000	17.809	Yes
NFSR #3 vs NFSR #8	2905.500	20.305	Yes
NFSR #3 vs NFSR #5	187.000	1.955	No
NFSR #5 vs LDC #2	5456.500	9.573	Yes
NFSR #5 vs NFSR #1	4716.000	9.025	Yes
NFSR #5 vs Horse Creek #1	4614.500	9.712	Yes
NFSR #5 vs Cedar Creek #1	4566.000	10.676	Yes
NFSR #5 vs NFSR #7	4506.500	11.851	Yes
NFSR #5 vs NFSR #10	4196.500	12.609	Yes
NFSR #5 vs LDC #1	4192.500	14.690	Yes
NFSR #5 vs NFSR #9	4066.000	17.087	Yes
NFSR #5 vs NFSR #6	4024.500	21.123	Yes
NFSR #5 vs NFSR #2	3206.000	22.405	Yes
NFSR #5 vs NFSR #8	2718.500	28.420	Yes
NFSR #8 vs LDC #2	2738.000	5.240	Yes
NFSR #8 vs NFSR #1	1997.500	4.204	No
NFSR #8 vs Horse Creek #1	1896.000	4.433	Do Not Test
NFSR #8 vs Cedar Creek #1	1847.500	4.858	Do Not Test
NFSR #8 vs NFSR #7	1788.000	5.372	Do Not Test
NFSR #8 vs NFSR #10	1478.000	5.179	Do Not Test
NFSR #8 vs LDC #1	1474.000	6.194	Do Not Test
NFSR #8 vs NFSR #9	1347.500	7.073	Do Not Test
NFSR #8 vs NFSR #6	1306.000	9.127	Do Not Test
NFSR #8 vs NFSR #2	487.500	5.096	Do Not Test
NFSR #2 vs LDC #2	2250.500	4.737	Yes
NFSR #2 vs NFSR #1	1510.000	3.531	Do Not Test
NFSR #2 vs Horse Creek #1	1408.500	3.704	Do Not Test
NFSR #2 vs Cedar Creek #1	1360.000	4.086	Do Not Test
NFSR #2 vs NFSR #7	1300.500	4.557	Do Not Test
NFSR #2 vs NFSR #10	990.500	4.162	Do Not Test
NFSR #2 vs LDC #1	986.500	5.178	Do Not Test
NFSR #2 vs NFSR #9	860.000	6.010	Do Not Test
NFSR #2 vs NFSR #6	818.500	8.557	Do Not Test
NFSR #6 vs LDC #2	1432.000	3.348	No
NFSR #6 vs NFSR #1	691.500	1.818	Do Not Test
NFSR #6 vs Horse Creek #1	590.000	1.773	Do Not Test
NFSR #6 vs Cedar Creek #1	541.500	1.897	Do Not Test
NFSR #6 vs NFSR #7	482.000	2.026	Do Not Test
NFSR #6 vs NFSR #10	172.000	0.903	Do Not Test
NFSR #6 vs LDC #1	168.000	1.174	Do Not Test
NFSR #6 vs NFSR #9	41.500	0.434	Do Not Test
NFSR #9 vs LDC #2	1390.500	3.657	Do Not Test
NFSR #9 vs NFSR #1	650.000	1.953	Do Not Test
NFSR #9 vs Horse Creek #1	548.500	1.922	Do Not Test
NFSR #9 vs Cedar Creek #1	500.000	2.101	Do Not Test
NFSR #9 vs NFSR #7	440.500	2.312	Do Not Test
NFSR #9 vs NFSR #10	130.500	0.912	Do Not Test

NFSR #9 vs LDC #1	126.500	1.322	Do Not Test
LDC #1 vs LDC #2	1264.000	3.798	Do Not Test
LDC #1 vs NFSR #1	523.500	1.834	Do Not Test
LDC #1 vs Horse Creek #1	422.000	1.773	Do Not Test
LDC #1 vs Cedar Creek #1	373.500	1.960	Do Not Test
LDC #1 vs NFSR #7	314.000	2.194	Do Not Test
LDC #1 vs NFSR #10	4.000	0.0418	Do Not Test
NFSR #10 vs LDC #2	1260.000	4.415	Do Not Test
NFSR #10 vs NFSR #1	519.500	2.183	Do Not Test
NFSR #10 vs Horse Creek #1	418.000	2.194	Do Not Test
NFSR #10 vs Cedar Creek #1	369.500	2.582	Do Not Test
NFSR #10 vs NFSR #7	310.000	3.241	Do Not Test
NFSR #7 vs LDC #2	950.000	3.992	Do Not Test
NFSR #7 vs NFSR #1	209.500	1.100	Do Not Test
NFSR #7 vs Horse Creek #1	108.000	0.755	Do Not Test
NFSR #7 vs Cedar Creek #1	59.500	0.622	Do Not Test
Cedar Creek #1 vs LDC #2	890.500	4.674	Do Not Test
Cedar Creek #1 vs NFSR #1	150.000	1.048	Do Not Test
Cedar Creek # vs Horse Creek #	48.500	0.507	Do Not Test
Horse Creek #1 vs LDC #2	842.000	5.884	Do Not Test
Horse Creek #1 vs NFSR #1	101.500	1.061	Do Not Test
NFSR #1 vs LDC #2	740.500	7.741	Do Not Test

Note: The multiple comparisons on ranks do not include an adjustment for ties.

A result of "Do Not Test" occurs for a comparison when no significant difference is found between the two rank sums that enclose that comparison. For example, if you had four rank sums sorted in order, and found no significant difference between rank sums 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed rank sums is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the rank sums, even though one may appear to exist.

One Way Analysis of Variance Tuesday, February 19, 2008, 2:49:58 PM

Data source: Channel Measurements

Dependent Variable: log10 (Wetted Width to Water Depth Ratio)

Normality Test: Passed (P = 0.140)

Equal Variance Test: Passed (P = 0.112)

Group Name	N	Missing	Mean	Std Dev	SEM
NFSR #1	10	0	1.740	0.299	0.0945
NFSR #2	10	0	1.529	0.241	0.0762
NFSR #3	10	0	1.224	0.152	0.0479
NFSR #4	10	0	1.224	0.102	0.0323
NFSR #5	10	0	1.259	0.109	0.0344
NFSR #6	10	0	1.165	0.190	0.0601
NFSR #7	10	0	1.423	0.198	0.0627
NFSR #8	10	0	1.468	0.119	0.0376
NFSR #9	10	0	1.492	0.149	0.0471
NFSR #10	10	0	1.416	0.265	0.0837
Horse Creek #1	10	0	1.408	0.237	0.0750
Cedar Creek #1	10	0	1.546	0.213	0.0675
LDC #1	10	0	1.330	0.154	0.0488
LDC #2	10	0	1.276	0.120	0.0381

Source of Variation	DF	SS	MS	F	P
Between Groups	13	3.245	0.250	6.793	<0.001
Residual	126	4.630	0.0367		
Total	139	7.875			

The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001).

Power of performed test with alpha = 0.050: 1.000

All Pairwise Multiple Comparison Procedures (Student-Newman-Keuls Method):

Comparisons for factor: **Station**

Comparison	Diff of Means	p	q	P	P<0.050
NFSR #1 vs. NFSR #6	0.575	14	9.480	<0.001	Yes
NFSR #1 vs. NFSR #4	0.517	13	8.521	<0.001	Yes
NFSR #1 vs. NFSR #3	0.516	12	8.520	<0.001	Yes
NFSR #1 vs. NFSR #5	0.481	11	7.938	<0.001	Yes
NFSR #1 vs. LDC #2	0.464	10	7.648	<0.001	Yes
NFSR #1 vs. LDC #1	0.410	9	6.767	<0.001	Yes
NFSR #1 vs. Horse Creek #1	0.332	8	5.481	0.003	Yes
NFSR #1 vs. NFSR #10	0.325	7	5.353	0.003	Yes
NFSR #1 vs. NFSR #7	0.317	6	5.237	0.003	Yes
NFSR #1 vs. NFSR #8	0.272	5	4.488	0.013	Yes
NFSR #1 vs. NFSR #9	0.248	4	4.085	0.020	Yes
NFSR #1 vs. NFSR #2	0.211	3	3.475	0.037	Yes
NFSR #1 vs. Cedar Creek #1	0.194	2	3.194	0.024	Yes
Cedar Creek #1 vs. NFSR #6	0.381	13	6.286	<0.001	Yes

Cedar Creek #1 vs. NFSR #4	0.323	12	5.327	0.009	Yes
Cedar Creek #1 vs. NFSR #3	0.323	11	5.326	0.008	Yes
Cedar Creek #1 vs. NFSR #5	0.288	10	4.744	0.027	Yes
Cedar Creek #1 vs. LDC #2	0.270	9	4.454	0.043	Yes
Cedar Creek #1 vs. LDC #1	0.217	8	3.573	0.184	No
Cedar Creek vs. Horse Creek	0.139	7	2.288	0.671	Do Not Test
Cedar Creek #1 vs. NFSR #10	0.131	6	2.159	0.647	Do Not Test
Cedar Creek #1 vs. NFSR #7	0.124	5	2.044	0.598	Do Not Test
Cedar Creek #1 vs. NFSR #8	0.0785	4	1.294	0.797	Do Not Test
Cedar Creek #1 vs. NFSR #9	0.0540	3	0.891	0.804	Do Not Test
Cedar Creek #1 vs. NFSR #2	0.0171	2	0.281	0.842	Do Not Test
NFSR #2 vs. NFSR #6	0.364	12	6.005	0.001	Yes
NFSR #2 vs. NFSR #4	0.306	11	5.046	0.016	Yes
NFSR #2 vs. NFSR #3	0.306	10	5.044	0.013	Yes
NFSR #2 vs. NFSR #5	0.271	9	4.463	0.042	Yes
NFSR #2 vs. LDC #2	0.253	8	4.173	0.063	No
NFSR #2 vs. LDC #1	0.200	7	3.292	0.231	Do Not Test
NFSR #2 vs. Horse Creek #1	0.122	6	2.006	0.716	Do Not Test
NFSR #2 vs. NFSR #10	0.114	5	1.878	0.674	Do Not Test
NFSR #2 vs. NFSR #7	0.107	4	1.762	0.597	Do Not Test
NFSR #2 vs. NFSR #8	0.0614	3	1.013	0.754	Do Not Test
NFSR #2 vs. NFSR #9	0.0370	2	0.610	0.666	Do Not Test
NFSR #9 vs. NFSR #6	0.327	11	5.395	0.006	Yes
NFSR #9 vs. NFSR #4	0.269	10	4.436	0.054	No
NFSR #9 vs. NFSR #3	0.269	9	4.435	0.045	Do Not Test
NFSR #9 vs. NFSR #5	0.234	8	3.853	0.115	Do Not Test
NFSR #9 vs. LDC #2	0.216	7	3.563	0.152	Do Not Test
NFSR #9 vs. LDC #1	0.163	6	2.682	0.404	Do Not Test
NFSR #9 vs. Horse Creek #1	0.0847	5	1.397	0.861	Do Not Test
NFSR #9 vs. NFSR #10	0.0769	4	1.269	0.806	Do Not Test
NFSR #9 vs. NFSR #7	0.0699	3	1.153	0.694	Do Not Test
NFSR #9 vs. NFSR #8	0.0244	2	0.403	0.776	Do Not Test
NFSR #8 vs. NFSR #6	0.303	10	4.992	0.015	Yes
NFSR #8 vs. NFSR #4	0.244	9	4.033	0.101	Do Not Test
NFSR #8 vs. NFSR #3	0.244	8	4.032	0.083	Do Not Test
NFSR #8 vs. NFSR #5	0.209	7	3.450	0.182	Do Not Test
NFSR #8 vs. LDC #2	0.192	6	3.160	0.222	Do Not Test
NFSR #8 vs. LDC #1	0.138	5	2.279	0.490	Do Not Test
NFSR #8 vs. Horse Creek #1	0.0602	4	0.993	0.896	Do Not Test
NFSR #8 vs. NFSR #10	0.0524	3	0.865	0.814	Do Not Test
NFSR #8 vs. NFSR #7	0.0454	2	0.749	0.596	Do Not Test
NFSR #7 vs. NFSR #6	0.257	9	4.242	0.067	No
NFSR #7 vs. NFSR #4	0.199	8	3.283	0.282	Do Not Test
NFSR #7 vs. NFSR #3	0.199	7	3.282	0.234	Do Not Test
NFSR #7 vs. NFSR #5	0.164	6	2.701	0.396	Do Not Test
NFSR #7 vs. LDC #2	0.146	5	2.411	0.431	Do Not Test
NFSR #7 vs. LDC #1	0.0927	4	1.530	0.701	Do Not Test
NFSR #7 vs. Horse Creek #1	0.0148	3	0.244	0.984	Do Not Test
NFSR #7 vs. NFSR #10	0.00703	2	0.116	0.935	Do Not Test
NFSR #10 vs. NFSR #6	0.250	8	4.126	0.069	Do Not Test
NFSR #10 vs. NFSR #4	0.192	7	3.167	0.274	Do Not Test
NFSR #10 vs. NFSR #3	0.192	6	3.166	0.220	Do Not Test
NFSR #10 vs. NFSR #5	0.157	5	2.585	0.357	Do Not Test
NFSR #10 vs. LDC #2	0.139	4	2.295	0.366	Do Not Test
NFSR #10 vs. LDC #1	0.0857	3	1.414	0.577	Do Not Test
NFSR #10 vs. Horse Creek #1	0.00777	2	0.128	0.928	Do Not Test

Horse Creek #1 vs. NFSR #6	0.242	7	3.998	0.070	Do Not Test
Horse Creek #1 vs. NFSR #4	0.184	6	3.039	0.262	Do Not Test
Horse Creek #1 vs. NFSR #3	0.184	5	3.038	0.200	Do Not Test
Horse Creek #1 vs. NFSR #5	0.149	4	2.457	0.304	Do Not Test
Horse Creek #1 vs. LDC #2	0.131	3	2.167	0.276	Do Not Test
Horse Creek #1 vs. LDC #1	0.0779	2	1.286	0.363	Do Not Test
LDC #1 vs. NFSR #6	0.164	6	2.713	0.391	Do Not Test
LDC #1 vs. NFSR #4	0.106	5	1.754	0.728	Do Not Test
LDC #1 vs. NFSR #3	0.106	4	1.753	0.602	Do Not Test
LDC #1 vs. NFSR #5	0.0710	3	1.171	0.686	Do Not Test
LDC #1 vs. LDC #2	0.0534	2	0.881	0.533	Do Not Test
LDC #2 vs. NFSR #6	0.111	5	1.832	0.694	Do Not Test
LDC #2 vs. NFSR #4	0.0529	4	0.873	0.927	Do Not Test
LDC #2 vs. NFSR #3	0.0528	3	0.872	0.811	Do Not Test
LDC #2 vs. NFSR #5	0.0176	2	0.290	0.837	Do Not Test
NFSR #5 vs. NFSR #6	0.0934	4	1.541	0.696	Do Not Test
NFSR #5 vs. NFSR #4	0.0353	3	0.583	0.911	Do Not Test
NFSR #5 vs. NFSR #3	0.0352	2	0.581	0.681	Do Not Test
NFSR #3 vs. NFSR #6	0.0582	3	0.960	0.776	Do Not Test
NFSR #3 vs. NFSR #4	0.0000696	2	0.00115	0.999	Do Not Test
NFSR #4 vs. NFSR #6	0.0581	2	0.959	0.498	Do Not Test

A result of "Do Not Test" occurs for a comparison when no significant difference is found between two means that enclose that comparison. For example, if you had four means sorted in order, and found no difference between means 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed means is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the means, even though one may appear to exist.

Appendix G

North Fork of the Spring River Bioassessment Study Macroinvertebrate Bench Sheets

Aquid Invertebrate Database Bench Sheet Report
Little Drywood Ck [0602715], Station #1, Sample Date: 9/25/2006 2:00:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina	7	53	1
AMPHIPODA			
Hyalella azteca		35	1
ARHYNCHOBDELLIDA			
Erpobdellidae	1		-99
COLEOPTERA			
Dubiraphia	2	5	1
Dytiscidae		1	
Scirtidae		6	
Tropisternus		-99	
DECAPODA			
Palaemonetes kadiakensis	1	2	1
DIPTERA			
Ablabesmyia			1
Aedes		1	
Anopheles	1		1
Ceratopogoninae	14		2
Chaoborus	36	1	2
Chironomus	7		1
Cladotanytarsus			2
Clinotanypus	1		1
Cryptochironomus			1
Dicrotendipes	6	4	26
Forcipomyiinae	1		
Glyptotendipes	12	25	171
Kiefferulus	5	7	2
Microtendipes		2	
Parachironomus	1	7	
Paratanytarsus		3	
Polypedilum illinoense grp		1	2
Polypedilum scalaenum grp		1	
Procladius	86	2	7
Stenochironomus	2		
Tanypus	6		
Tanytarsus	7	4	3
Thienemannimyia grp.			1
Tipula		1	
Tribelos	1		7
EPHEMEROPTERA			
Caenis latipennis	2	4	

Aquid Invertebrate Database Bench Sheet Report
Little Drywood Ck [0602715], Station #1, Sample Date: 9/25/2006 2:00:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Callibaetis	2	1	
Leptophlebiidae	1	15	
Procloeon	1	1	1
Stenacron	12	54	20
Stenonema femoratum			1
HEMIPTERA			
Corixidae	18		3
Ranatra kirkaldyi	-99		
ISOPODA			
Lirceus		26	1
LIMNOPHILA			
Ancylidae	1	2	2
Fossaria	1		
Menetus		7	
Physella	1	20	1
MEGALOPTERA			
Sialis	4		
MESOGASTROPODA			
Hydrobiidae	1	4	
ODONATA			
Argia		7	
Libellulidae	1		
Nasiaeschna pentacantha		-99	
RHYNCHOBDELLIDA			
Glossiphoniidae			-99
TRICHOPTERA			
Triaenodes		4	
TRICLADIDA			
Planariidae		2	
TUBIFICIDA			
Branchiura sowerbyi	13	3	
Ilyodrilus templetoni	26		
Tubificidae	93	15	2
VENEROIDEA			
Sphaeriidae	-99	10	

Aquid Invertebrate Database Bench Sheet Report
Little Drywood Ck [0602716], Station #2, Sample Date: 9/25/2006 4:00:00 PM
NF = Nonflow; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	SG
"HYDRACARINA"		
Acarina	12	26
AMPHIPODA		
Hyalella azteca		7
ARHYNCHOBDELLIDA		
Erpobdellidae	-99	1
COLEOPTERA		
Dubiraphia	1	3
Helichus lithophilus		1
Scirtidae		1
DECAPODA		
Palaemonetes kadiakensis	1	
DIPTERA		
Ablabesmyia		1
Ceratopogoninae	6	
Chaoborus	80	1
Chironomus	8	1
Chrysops	1	
Cryptochironomus	1	
Dicrotendipes	1	50
Diptera		1
Glyptotendipes	11	137
Hydrobaenus	1	
Kiefferulus	4	18
Microtendipes		1
Nanocladius		1
Natarsia		1
Parachironomus	3	
Paratanytarsus		1
Polypedilum fallax grp		1
Polypedilum illinoense grp		5
Procladius	98	
Stenochironomus		1
Stictochironomus	3	
Tanypus	4	
Tanytarsus	1	
Thienemannimyia grp.		1
Tribelos		19
EPHEMEROPTERA		
Caenis latipennis	2	2

Aquid Invertebrate Database Bench Sheet Report
Little Drywood Ck [0602716], Station #2, Sample Date: 9/25/2006 4:00:00 PM
NF = Nonflow; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	SG
Leptophlebiidae	1	
Procloeon	1	
Stenacron	8	21
HEMIPTERA		
Corixidae	1	
ISOPODA		
Lirceus		1
LIMNOPHILA		
Helisoma		2
Physella		1
MEGALOPTERA		
Chauliodes rastricornis		1
Sialis	-99	2
TUBIFICIDA		
Ilyodrilus templetoni	1	
Limnodrilus hoffmeisteri	1	
Tubificidae	25	13
VENEROIDEA		
Sphaeriidae		4

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0602717], Station #1, Sample Date: 9/28/2006 8:30:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	CS	NF	RM	SG
"HYDRACARINA"				
Acarina		11	6	17
AMPHIPODA				
Hyalella azteca	12		153	15
ARHYNCHOBDELLIDA				
Erpobdellidae	-99	-99		
BRANCHIOBDELLIDA				
Branchiobdellida			1	
COLEOPTERA				
Berosus	26	1	2	1
Dineutus	2			
Dubiraphia	3	3	74	9
Ectopria nervosa	2			
Hydrochus				1
Neoporus	2		1	1
Peltodytes			1	
Psephenus herricki	2			
Scirtidae	2		12	6
Stenelmis	112		1	
Tropisternus	-99			
DECAPODA				
Orconectes neglectus	-99		-99	
Orconectes virilis			1	
DIPTERA				
Ablabesmyia	3		2	3
Ceratopogoninae	3	4	1	1
Chaoborus		1		
Chironomus		1	1	
Clinotanypus	1	2	2	
Coelotanypus		4		
Cricotopus bicinctus	5			
Cricotopus/Orthocladius	4			
Cryptochironomus	6			
Cryptotendipes		1		
Culex			1	
Dicrotendipes	14	5		32
Forcipomyiinae				22
Glyptotendipes	18	2	16	101
Kiefferulus	2	1	1	3
Labrundinia		3	5	

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0602717], Station #1, Sample Date: 9/28/2006 8:30:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	CS	NF	RM	SG
Limnophila				1
Parakiefferiella				1
Paratanytarsus	1			1
Polypedilum convictum	120		1	
Polypedilum illinoense grp	25		13	25
Polypedilum scalaenum grp	3			
Procladius		4		
Simulium	1			
Stelechomyia				1
Stenochironomus				1
Tabanus	-99			
Tanytarsus	48		2	5
Thienemannimyia grp.	4			
Tribelos		1		22
EPHEMEROPTERA				
Apobaetis		1		
Caenis latipennis	72	1	5	2
Callibaetis		4	4	6
Hexagenia limbata		-99		
Stenacron	7		1	17
Stenonema femoratum	4			
HEMIPTERA				
Belostoma	-99			
Corixidae	3	88	1	9
Palmacorixa		2		1
Rheumatobates			1	1
Trepobates	1			1
Trichocorixa	7		1	
LIMNOPHILA				
Ancylidae	2	-99	1	8
Helisoma	1	-99	1	3
Lymnaeidae			1	5
Menetus	1	1	13	6
Physella	7		7	
Planorbella	1			1
LUMBRICINA				
Lumbricina	5			
MESOGASTROPODA				
Hydrobiidae	1	4	2	4
ODONATA				
Argia			7	1

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0602717], Station #1, Sample Date: 9/28/2006 8:30:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	CS	NF	RM	SG
Enallagma		1	18	
Gomphus			-99	
Ischnura			1	
Libellula	1	1	1	
Macromia		-99		
Somatochlora		1		2
PHARYNGOBDELLIDA				
Hirudinidae	1			
RHYNCHOBDELLIDA				
Glossiphoniidae	7		2	-99
TRICHOPTERA				
Cheumatopsyche	9			
Hydroptila	2			
Oecetis			1	
Orthotrichia				1
TRICLADIDA				
Planariidae			2	1
TUBIFICIDA				
Aulodrilus	4	20		
Ilyodrilus templetoni	2	19		
Limnodrilus cervix		2		
Limnodrilus hoffmeisteri		2		
Quistradrilus multisetosus	13	42	3	3
Tubificidae	71	112		4
VENEROIDEA				
Sphaeriidae	11	2	4	

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0602718], Station #2, Sample Date: 9/27/2006 3:45:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina	1	4	
AMPHIPODA			
Hyalella azteca		47	48
COLEOPTERA			
Berosus	3		
Dubiraphia	1	4	1
Hydroporus		1	
Scirtidae		19	1
Stenelmis		1	
Uvarus		1	
DIPTERA			
Ablabesmyia	1	2	4
Anopheles		1	
Ceratopogoninae	3		
Chaoborus	6		
Cladopelma	2		
Cladotanytarsus	6		
Cryptochironomus	1		1
Culex		3	
Dasyheleinae			1
Dicrotendipes	14	15	41
Endochironomus		1	1
Ephydridae		1	
Forcipomyiinae			1
Glyptotendipes	10	69	145
Goeldichironomus		1	2
Kiefferulus	2	7	3
Labrundinia	1	2	
Nanocladius		1	
Parachironomus		5	
Paraphaenocladius		1	
Paratanytarsus		4	1
Polypedilum illinoense grp	2	24	2
Polypedilum scalaenum grp	2		
Procladius	9		1
Pseudosmittia	1	3	
Tanypus	2		
Tanytarsus	74	10	14
Tribelos			7

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0602718], Station #2, Sample Date: 9/27/2006 3:45:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Zavreliella	1		
EPHEMEROPTERA			
Caenis latipennis	77	17	26
Callibaetis	4	11	
Heptageniidae	1		
Hexagenia	1		
Procloeon			1
Stenacron		4	5
HEMIPTERA			
Belostoma		1	
Corixidae	9	3	
Neoplea		2	
Ranatra buenoi		-99	
Ranatra kirkaldyi		1	
Trepobates		1	
LIMNOPHILA			
Ferrissia	1		
Lymnaeidae			1
Menetus		1	
Physella	1		
NEUROPTERA			
Climacia		1	
ODONATA			
Argia			1
Enallagma		2	
Ischnura		1	
Libellulidae		2	1
Somatochlora		-99	1
RHYNCHOBDELLIDA			
Glossiphoniidae	9		
TRICLADIDA			
Planariidae	1	2	2
TUBIFICIDA			
Aulodrilus	21		
Enchytraeidae		1	
Ilyodrilus templetoni	10	1	
Quistradrilus multisetosus	38	3	1
Tubificidae	54	3	2
VENEROIDEA			
Corbicula	5		

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0602718], Station #2, Sample Date: 9/27/2006 3:45:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Sphaeriidae		1	1

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0602719], Station #3, Sample Date: 9/27/2006 1:15:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina	9	12	
AMPHIPODA			
Hyalella azteca	12	151	103
ARHYNCHOBDELLIDA			
Erpobdellidae	6	6	
COLEOPTERA			
Berosus			1
Dubiraphia		1	
Peltodytes			1
Scirtidae		14	
DIPTERA			
Ablabesmyia	5	1	2
Chaoborus	114	2	1
Cladopelma	2		
Clinotanypus		1	1
Cryptochironomus	3		1
Dicrotendipes	22	27	55
Diptera		1	
Forcipomyiinae	13		
Glyptotendipes		3	25
Labrundinia		1	3
Paratanytarsus		1	
Polypedilum illinoense grp	1	13	6
Procladius	17	2	1
Stenochironomus	1		
Tanypus	6	1	
Tanytarsus	4	14	5
Thienemannimyia grp.			1
Tribelos	3	5	53
EPHEMEROPTERA			
Caenis latipennis	6	4	
Callibaetis		5	1
Hexagenia limbata	2	1	
Procloeon	1		1
Stenacron	8	1	13
HEMIPTERA			
Corixidae	8	1	1
Ranatra fusca		1	
ISOPODA			

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0602719], Station #3, Sample Date: 9/27/2006 1:15:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Lirceus		6	
LIMNOPHILA			
Ancylidae			3
Lymnaeidae		1	
Menetus		4	2
Physella		7	1
Planorbella		2	
MEGALOPTERA			
Chauliodes rastricornis		1	
NEUROPTERA			
Climacia		1	
ODONATA			
Argia		1	5
Libellula		1	
Libellulidae	1		
Macromia	-99		
Nasiaeschna pentacantha		-99	
TRICHOPTERA			
Cyrnellus fraternus	1		4
Hydroptila		1	
Oecetis		2	1
TRICLADIDA			
Planariidae		4	
TUBIFICIDA			
Aulodrilus	8	10	2
Branchiura sowerbyi	2		
Ilyodrilus templetoni	15		
Limnodrilus hoffmeisteri	1		
Quistradrilus multisetosus	9		
Tubificidae	36	10	2
VENEROIDEA			
Corbicula			-99
Sphaeriidae		-99	1

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0602720], Station #4a, Sample Date: 9/27/2006 8:30:00 AM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina	4	10	
AMPHIPODA			
Hyalella azteca		35	56
COLEOPTERA			
Dubiraphia		1	2
Paracymus			1
Peltodytes		1	1
Scirtidae	1	64	13
Tropisternus		1	
DIPTERA			
Ceratopogoninae	30	2	1
Chaoborus	34		
Chironomus	6		2
Cladopelma	1		
Cryptochironomus		1	
Dicrotendipes	4	20	21
Einfeldia	2		
Forcipomyiinae		3	23
Glyptotendipes	11	17	169
Goeldichironomus		2	
Kiefferulus	10	4	9
Labrundinia		2	
Parachironomus		7	
Polypedilum halterale grp	3		
Polypedilum illinoense grp	2	68	5
Procladius	15	1	2
Tanypus	5		1
Tanytarsus	18	1	6
Tribelos			4
Zavreliella	2		
EPHEMEROPTERA			
Caenis latipennis	15	4	5
HEMIPTERA			
Corixidae	1	1	
Neoplea		1	1
Nepa		1	
ISOPODA			
Lirceus		2	
LIMNOPHILA			

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0602720], Station #4a, Sample Date: 9/27/2006 8:30:00 AM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Ancylidae	1		1
Fossaria			1
Menetus			2
MEGALOPTERA			
Chauliodes rastricornis		3	
ODONATA			
Argia			4
Enallagma		1	
Ischnura		2	1
Libellula		-99	
Libellulidae	4		2
Nasiaeschna pentacantha		2	
Pachydiplax longipennis			1
Plathemis		-99	
Somatochlora	3	1	1
TRICHOPTERA			
Orthotrichia	1		
TUBIFICIDA			
Aulodrilus	111		
Branchiura sowerbyi	5		
Ilyodrilus templetoni	17		
Limnodrilus hoffmeisteri	2		
Quistradrilus multisetosus	104		2
Tubificidae	23	4	4
VENEROIDEA			
Sphaeriidae	1		1

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0602721], Station #5, Sample Date: 9/26/2006 1:00:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina	7	5	
AMPHIPODA			
Hyalella azteca	3	151	62
COLEOPTERA			
Dubiraphia		1	
Hydrochus		1	
Scirtidae		20	2
DECAPODA			
Orconectes			-99
DIPTERA			
Anopheles		2	
Ceratopogoninae	17	2	1
Chaoborus	72		
Chironomus	4	2	
Chrysops		2	
Cladopelma	1		
Cladotanytarsus	1		
Clinotanypus	1		1
Culex		12	1
Dicrotendipes	2	5	13
Diptera			1
Einfeldia	4		
Forcipomyiinae			5
Glyptotendipes	26	96	267
Goeldichironomus		2	
Kiefferulus	1	2	
Labrundinia		2	
Nanocladius		1	
Parachironomus	1	12	1
Polypedilum halterale grp	1		
Polypedilum illinoense grp		5	1
Procladius	41	4	
Tanypus	22	1	
Tanytarsus	38	6	1
Tribelos			2
Zavreliella	2		
EPHEMEROPTERA			
Caenis latipennis	10	3	2
Leptophlebiidae		1	

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0602721], Station #5, Sample Date: 9/26/2006 1:00:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Stenacron			1
HEMIPTERA			
Belostoma		-99	-99
Corixidae	7	4	1
Microvelia		1	
Palmacorixa		1	
Ranatra nigra		1	
Trepobates		1	
ISOPODA			
Lirceus		2	
LIMNOPHILA			
Ancylidae	1		
Physella		8	
MEGALOPTERA			
Sialis	2		
ODONATA			
Argia		2	1
Enallagma		18	1
Libellula		-99	
Libellulidae	1	1	1
Nasiaeschna pentacantha		-99	
Pachydiplax longipennis		2	1
Plathemis		3	
Somatochlora	4	1	
TRICLADIDA			
Planariidae		17	1
TUBIFICIDA			
Aulodrilus	20		
Branchiura sowerbyi	6	1	
Ilyodrilus templetoni	18		
Limnodrilus hoffmeisteri	2		
Quistradrilus multisetosus	11		
Tubificidae	47	12	
VENEROIDEA			
Sphaeriidae			-99

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0602722], Station #4b, Sample Date: 9/27/2006 8:30:00 AM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina	3	20	1
AMPHIPODA			
Hyalella azteca		78	22
COLEOPTERA			
Dineutus		1	1
Dubiraphia		3	
Hydrochus		3	
Peltodytes			1
Scirtidae		54	11
DIPTERA			
Anopheles		2	
Ceratopogoninae	17	1	1
Chaoborus	12		2
Chironomus	6		
Cryptochironomus	2		
Culex		1	
Dicrotendipes	5	15	34
Endochironomus		1	
Forcipomyiinae		3	6
Glyptotendipes	6	35	192
Goeldichironomus		2	
Kiefferulus	2	9	6
Labrundinia		1	
Nanocladius		1	
Parachironomus		6	
Polypedilum halterale grp	2		
Polypedilum illinoense grp		31	15
Procladius	18	1	1
Tanypus	5	2	
Tanytarsus	15	6	
Tribelos		1	
Zavreliella	2		
EPHEMEROPTERA			
Caenis latipennis	15	7	1
Callibaetis		2	
HEMIPTERA			
Belostoma		1	
Corixidae	1	4	
Neoplea		2	

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0602722], Station #4b, Sample Date: 9/27/2006 8:30:00 AM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Ranatra fusca		-99	
Rheumatobates		2	
ISOPODA			
Lirceus		1	
LIMNOPHILA			
Lymnaeidae		2	2
Menetus		1	1
Physella		3	
MEGALOPTERA			
Sialis	-99		
ODONATA			
Argia		1	
Enallagma		1	1
Gomphidae			1
Libellulidae	4		1
Nasiaeschna pentacantha		-99	
Plathemis		-99	
Somatochlora	-99	-99	
RHYNCHOBDELLIDA			
Glossiphoniidae	1		
TRICHOPTERA			
Oecetis	1		
TRICLADIDA			
Planariidae		14	1
TUBIFICIDA			
Aulodrilus	184	2	1
Branchiura sowerbyi	4		1
Ilyodrilus templetoni	17		
Quistradrilus multisetosus	58		1
Tubificidae	49	8	3
VENEROIDEA			
Sphaeriidae		2	

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0602723], Station #6, Sample Date: 10/4/2006 8:30:00 AM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina	4	2	7
AMPHIPODA			
Hyalella azteca	1	86	
ARHYNCHOBDELLIDA			
Erpobdellidae	1		
COLEOPTERA			
Berosus	1		
Dubiraphia	24	32	1
Helichus lithophilus			1
Scirtidae		18	
Stenelmis		2	
DECAPODA			
Orconectes	-99		
Orconectes luteus		-99	
Procambarus acutus		-99	
DIPTERA			
Ablabesmyia	4	11	9
Ceratopogoninae	8		
Chaoborus	15	1	
Chironomus	1		
Chrysops	2		
Cladopelma	2		
Cladotanytarsus	2		2
Clinotanypus	2		
Corynoneura			1
Cricotopus/Orthocladius			1
Cryptochironomus	1		
Dicrotendipes	13	10	65
Glyptotendipes	1	4	46
Goeldichironomus		1	2
Kiefferulus	5	3	64
Labrundinia	1	4	
Parachironomus		12	
Parakiefferiella		2	
Polypedilum halterale grp	3		
Polypedilum illinoense grp		9	1
Procladius	57	2	
Pseudosmittia			4
Stenochironomus			1

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0602723], Station #6, Sample Date: 10/4/2006 8:30:00 AM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Tanypus	3		
Tanytarsus	13	3	8
Thienemannimyia grp.			1
Tribelos		1	15
undescribed Empididae		1	
Zavreliella	1		
EPHEMEROPTERA			
Caenis latipennis	27	76	12
Callibaetis	1		
Leptophlebiidae		2	1
Stenacron	5	5	20
Stenonema femoratum		2	9
HEMIPTERA			
Corixidae	1		
Neoplea		1	
ISOPODA			
Lirceus	1	36	2
LIMNOPHILA			
Ancylidae	4		2
Lymnaeidae		1	
Menetus	1	26	3
Physella	7	22	8
LUMBRICINA			
Lumbricina			2
MEGALOPTERA			
Chauliodes rastricornis		-99	
Sialis	5		
MESOGASTROPODA			
Hydrobiidae	2	12	
ODONATA			
Argia		3	1
Enallagma		22	
Gomphus	-99		
Libellula	-99		
Nasiaeschna pentacantha		-99	
Plathemis	1		
Somatochlora	1		
Tetragoneuria		1	
RHYNCHOBDELLIDA			
Glossiphoniidae		1	1

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0602723], Station #6, Sample Date: 10/4/2006 8:30:00 AM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
TRICHOPTERA			
Oecetis	1	4	
TUBIFICIDA			
Aulodrilus	9		
Branchiura sowerbyi	18	1	
Ilyodrilus templetoni	20	1	
Quistradrilus multisetosus		2	
Tubificidae	31	8	7
VENEROIDEA			
Corbicula		1	
Sphaeriidae	17	2	2

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0602724], Station #7, Sample Date: 10/3/2006 3:30:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina	4	6	1
AMPHIPODA			
Hyalella azteca		41	2
ARHYNCHOBDELLIDA			
Erpobdellidae			1
BRANCHIOBDELLIDA			
Branchiobdellida		1	
COLEOPTERA			
Ancyronyx variegatus		-99	1
Berosus			1
Dubiraphia	1	5	2
Hydrochus		-99	
Scirtidae		25	6
Tropisternus		-99	
DECAPODA			
Orconectes virilis		1	
DIPTERA			
Ablabesmyia		1	5
Anopheles		3	
Asheum beckae			1
Ceratopogoninae	14	2	2
Chaoborus	19	1	
Chironomus	2	1	
Chlorotabanus			1
Cladopelma	1		
Cladotanytarsus	2		
Cryptochironomus			1
Cryptotendipes	2		
Culex		-99	
Dicrotendipes	4	9	53
Diptera		1	1
Einfeldia	4		
Endochironomus	1		1
Forcipomyiinae		2	10
Glyptotendipes		7	126
Goeldichironomus		1	4
Kiefferulus	1	1	5
Nanocladius		3	
Parachironomus		4	

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0602724], Station #7, Sample Date: 10/3/2006 3:30:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Parakiefferiella	1	1	
Polypedilum halterale grp	2		
Polypedilum illinoense grp	1	1	7
Procladius	6	1	
Pseudosmittia			1
Stenochironomus			2
Stictochironomus	1		
Tanypus	2		
Tanytarsus	6	11	7
Zavreliella	7		
EPHEMEROPTERA			
Caenis latipennis	17	100	17
Callibaetis		3	1
Stenacron	1	3	3
Stenonema femoratum			2
HEMIPTERA			
Microvelia		1	
Neoplea		13	
Ranatra fusca		1	
Ranatra kirkaldyi		-99	
Ranatra nigra		-99	
Rheumatobates		1	
ISOPODA			
Lirceus		10	1
LIMNOPHILA			
Ancylidae	1	-99	3
Helisoma			1
Menetus		7	11
Physella		12	15
Pseudosuccinea		-99	
LUMBRICINA			
Lumbricina		-99	
LUMBRICULIDA			
Lumbriculidae		1	
MEGALOPTERA			
Chauliodes rastricornis			-99
MESOGASTROPODA			
Hydrobiidae			8
ODONATA			
Argia		1	5

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0602724], Station #7, Sample Date: 10/3/2006 3:30:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Basiaeschna janata		1	
Dromogomphus		-99	
Enallagma		19	
Ischnura		5	
Libellula		-99	
Libellulidae		1	
Nasiaeschna pentacantha		-99	
Perithemis		-99	
Plathemis		-99	
Tetragoneuria		-99	
RHYNCHOBDELLIDA			
Glossiphoniidae		1	
TRICHOPTERA			
Cyrnellus fraternus		1	
Leptoceridae		1	
Oecetis		15	
Orthotrichia		2	
TRICLADIDA			
Planariidae		6	2
TUBIFICIDA			
Aulodrilus	4	1	1
Branchiura sowerbyi	50		
Enchytraeidae	1		
Ilyodrilus templetoni	7	1	
Limnodrilus hoffmeisteri		1	
Quistradrilus multisetosus	3		
Tubificidae	57	15	8
VENEROIDEA			
Sphaeriidae	1	-99	7

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0602725], Station #8, Sample Date: 10/3/2006 1:00:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina	2	21	7
AMPHIPODA			
Crangonyx		-99	
ARHYNCHOBDELLIDA			
Erpobdellidae	-99	-99	1
BRANCHIOBDELLIDA			
Branchiobdellida		1	
COLEOPTERA			
Acilius		-99	
Dubiraphia	2	4	1
Hydroporus			-99
Scirtidae		9	
DECAPODA			
Orconectes virilis	1	-99	
DIPTERA			
Ablabesmyia		4	
Anopheles		1	
Ceratopogoninae	4		
Chaoborus	24		
Chironomus	3	2	
Chrysops		1	
Cladopelma	11		
Cryptochironomus	1		
Culex			2
Dicrotendipes	5	54	92
Einfeldia	2		
Forcipomyiinae			1
Glyptotendipes	2	23	171
Kiefferulus	6	40	24
Labrundinia		1	
Microtendipes	1		
Nanocladius		2	
Parachironomus		12	1
Paratanytarsus		3	
Paratendipes		1	
Procladius	42	1	5
Tanypus	30		
Tanytarsus	1	3	2
Tribelos		1	10

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0602725], Station #8, Sample Date: 10/3/2006 1:00:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
EPHEMEROPTERA			
Caenis latipennis	7	47	4
Leptophlebiidae		1	
Stenacron	1	1	4
HEMIPTERA			
Belostoma		-99	
Corixidae	5	1	
Ranatra buenoi		-99	
ISOPODA			
Lirceus		2	
LIMNOPHILA			
Ancylidae	2	3	1
Fossaria		4	
Helisoma		1	
Menetus		18	5
Physella		22	2
LUMBRICINA			
Lumbricina	2		
MEGALOPTERA			
Sialis	1	-99	
MESOGASTROPODA			
Hydrobiidae	2		
ODONATA			
Argia		1	
Basiaeschna janata		-99	
Enallagma		12	
Epicordulia		1	
Gomphus		-99	
Ischnura		1	
Libellula		-99	
Libellulidae		2	
Nasiaeschna pentacantha		-99	
Pachydiplax longipennis		1	
Somatochlora	3		
RHYNCHOBDELLIDA			
Glossiphoniidae		2	-99
TRICHOPTERA			
Oecetis			1
TRICLADIDA			
Planariidae		7	1

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0602725], Station #8, Sample Date: 10/3/2006 1:00:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
TUBIFICIDA			
Aulodrilus	1		
Branchiura sowerbyi	35	7	1
Ilyodrilus templetoni	12		1
Tubificidae	24	7	19
VENEROIDEA			
Sphaeriidae	9	9	2

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0602726], Station #9, Sample Date: 10/3/2006 11:00:00 AM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina	1	11	5
AMPHIPODA			
Hyalella azteca			1
ARHYNCHOBDELLIDA			
Erpobdellidae	1	-99	
BRANCHIOBDELLIDA			
Branchiobdellida		3	
COLEOPTERA			
Ancyronyx variegatus	1	1	3
Dineutus		-99	
Dubiraphia	4		2
Hydroporus		4	-99
Scirtidae		5	
Stenelmis	4	2	
Tropisternus		1	
DECAPODA			
Orconectes virilis		-99	
DIPTERA			
Ablabesmyia	6	4	4
Anopheles	1	3	4
Ceratopogoninae	7		
Chaoborus	13		
Chironomus	9	2	3
Cladopelma	3		
Cryptochironomus			2
Culex	1	1	1
Dicrotendipes	8	34	118
Endochironomus		1	
Glyptotendipes	4	18	54
Goeldichironomus		1	
Kiefferulus	7	15	33
Nanocladius		1	1
Parachironomus	1	5	1
Phaenopsectra			1
Polypedilum illinoense grp	2	2	4
Procladius	23	1	
Stenochironomus			1
Tanypus	10		
Tanytarsus	1	20	7

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0602726], Station #9, Sample Date: 10/3/2006 11:00:00 AM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Thienemannimyia grp.			1
Tribelos		2	10
EPHEMEROPTERA			
Caenis latipennis	14	30	21
Callibaetis		1	1
Stenacron			4
Stenonema femoratum		-99	6
HEMIPTERA			
Belostoma		-99	
Corixidae	4		
Ranatra buenoi		-99	
ISOPODA			
Lirceus		4	
LIMNOPHILA			
Ancylidae	8		5
Helisoma	-99		4
Lymnaeidae	2		
Menetus		14	2
Physella	2	2	6
MEGALOPTERA			
Chauliodes rastricornis			-99
Sialis		1	
ODONATA			
Enallagma	1	17	
Epicordulia		2	
Gomphus		-99	
Nasiaeschna pentacantha		-99	
Pachydiplax longipennis		1	1
Somatochlora		1	
RHYNCHOBDELLIDA			
Piscicolidae		1	
TRICLADIDA			
Planariidae	1	25	1
TUBIFICIDA			
Aulodrilus	1		
Branchiura sowerbyi	78		
Ilyodrilus templetoni	7		
Tubificidae	47	22	
VENEROIDEA			
Sphaeriidae	5	1	3

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0602727], Station #10, Sample Date: 10/3/2006 8:30:00 AM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina		5	
ARHYNCHOBDELLIDA			
Erpobdellidae	-99	-99	
COLEOPTERA			
Desmopachria		1	
Dubiraphia	1		
Gyrinus		2	
Helichus basalis	1		
Helichus lithophilus		1	
Hydrobius			1
Hydrochus		1	
Scirtidae		6	5
Stenelmis	2	2	
DIPTERA			
Ablabesmyia		2	
Anopheles		4	
Ceratopogoninae	32		
Chaoborus	1		
Chironomus	2	15	15
Cladopelma		1	
Culex	1	11	
Dasyheleinae	1		
Dicrotendipes		21	42
Diptera		4	2
Endochironomus			2
Ephydridae	1		
Glyptotendipes	1	17	56
Goeldichironomus	1	35	56
Kiefferulus	1	32	54
Mesosmittia	2	1	
Nanocladius		1	
Nemotelus	-99		
Parachironomus		7	1
Phaenopsectra		2	
Polypedilum illinoense grp		1	
Procladius	2		1
Pseudosmittia		1	2
Tabanus		1	
Tanypus	1		

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0602727], Station #10, Sample Date: 10/3/2006 8:30:00 AM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Tanytarsus		6	1
EPHEMEROPTERA			
Caenis latipennis		7	2
HEMIPTERA			
Belostoma		-99	
Corixidae	1		
Nepa		-99	
ISOPODA			
Lirceus		6	
LIMNOPHILA			
Ancylidae	5	9	
Fossaria		4	
Helisoma		1	
Menetus	1	4	
Physella	3	9	7
Planorbella		2	
LUMBRICULIDA			
Lumbriculidae	1		
MEGALOPTERA			
Sialis	1		
MESOGASTROPODA			
Hydrobiidae		2	2
ODONATA			
Enallagma		4	
Epicordulia		-99	
Erythemis			1
Ischnura		3	1
Libellula		2	
Libellulidae	1		
Nasiaeschna pentacantha		1	
Pachydiplax longipennis		-99	
Somatochlora	-99	1	
RHYNCHOBDELLIDA			
Glossiphoniidae	-99	-99	1
TRICLADIDA			
Planariidae		1	
TUBIFICIDA			
Branchiura sowerbyi	100	2	
Ilyodrilus templetoni	21	9	
Tubificidae	157	37	1

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0602727], Station #10, Sample Date: 10/3/2006 8:30:00 AM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
VENEROIDEA			
Sphaeriidae	26	46	4

Aquid Invertebrate Database Bench Sheet Report
Horse Ck [0602728], Station #1, Sample Date: 10/2/2006 10:45:00 AM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina	5	29	18
AMPHIPODA			
Hyalella azteca		102	9
ARHYNCHOBDELLIDA			
Erpobdellidae	-99		
COLEOPTERA			
Ancyronyx variegatus		3	2
Dubiraphia	22	21	7
Hydroporus		1	1
Macronychus glabratus		1	
Scirtidae		2	
DECAPODA			
Orconectes luteus	1		1
Orconectes virilis		-99	
DIPTERA			
Ablabesmyia	2		2
Ceratopogoninae	6		1
Chaoborus	17		
Chironomus	13	1	
Clinotanypus		2	
Cricotopus/Orthocladius			1
Cryptochironomus	1		1
Dicrotendipes	1	4	40
Forcipomyiinae			4
Glyptotendipes	1	11	23
Goeldichironomus		1	
Kiefferulus	7	50	6
Labrundinia		1	
Parachironomus		2	1
Paratanytarsus		1	1
Polypedilum illinoense grp	1	5	1
Procladius	28	1	8
Pseudochironomus			4
Stenochironomus			1
Tanypus	7		
Tanytarsus	11	1	7
Thienemannimyia grp.			5
Tribelos	3		14
Xenochironomus			3

Aquid Invertebrate Database Bench Sheet Report
Horse Ck [0602728], Station #1, Sample Date: 10/2/2006 10:45:00 AM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Zavreliella	1	1	
EPHEMEROPTERA			
Baetidae			1
Caenis latipennis	53	20	48
Callibaetis			1
Leptophlebiidae	1	6	2
Stenacron	1		2
Stenonema femoratum			5
LIMNOPHILA			
Ancylidae		4	10
Helisoma			2
Menetus		19	4
Physella		5	6
Planorbella			3
MEGALOPTERA			
Sialis		-99	
ODONATA			
Argia		1	
Enallagma		26	
Hagenius brevistylus		-99	
Ischnura		2	
Pachydiplax longipennis	1	-99	
Tetragoneuria		1	
RHYNCHOBDELLIDA			
Glossiphoniidae		1	
TRICHOPTERA			
Oecetis	1		
TRICLADIDA			
Planariidae		10	1
TUBIFICIDA			
Aulodrilus	13		7
Branchiura sowerbyi	3	1	
Ilyodrilus templetoni	6		1
Limnodrilus hoffmeisteri	2		
Quistradrilus multisetosus	4	2	
Tubificidae	123	1	28
VENEROIDEA			
Sphaeriidae	1	-99	

Aquid Invertebrate Database Bench Sheet Report
Cedar Ck [0602729], Station #1, Sample Date: 10/2/2006 2:00:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina	3	3	
AMPHIPODA			
Hyalella azteca	6	140	1
ARHYNCHOBDELLIDA			
Erpobdellidae	4		1
COLEOPTERA			
Berosus	1		
Dineutus		-99	
Dubiraphia		2	
Hydrochus		3	
Hydroporus	5	9	2
Peltodytes	1		
Scirtidae	1	19	
Tropisternus		-99	
DIPTERA			
Ceratopogoninae	24		1
Chaoborus	18	1	2
Chironomus	55	10	17
Dicrotendipes	9	45	32
Ephydridae		1	
Glyptotendipes		26	133
Goeldichironomus	13	16	71
Kiefferulus		12	12
Labrundinia	5		
Larsia	1		
Parachironomus	1	6	
Procladius	7	3	3
Psychoda			2
Tanytarsus	34	1	12
Thienemannimyia grp.	11	3	
EPHEMEROPTERA			
Caenis latipennis	2		
Callibaetis	3	1	2
HEMIPTERA			
Corixidae	2		5
Ranatra buenoi		-99	
LIMNOPHILA			
Ancylidae	1		1
Menetus	1	7	

Aquid Invertebrate Database Bench Sheet Report
Cedar Ck [0602729], Station #1, Sample Date: 10/2/2006 2:00:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Physella	7	21	3
Planorbella	1		
LUMBRICINA			
Lumbricina	1	-99	
ODONATA			
Epicordulia		-99	
Pachydiplax longipennis		-99	
Perithemis			1
Somatochlora	-99	-99	
RHYNCHOBDELLIDA			
Glossiphoniidae	2	5	
TRICLADIDA			
Planariidae	6	20	
TUBIFICIDA			
Branchiura sowerbyi	10	1	1
Limnodrilus hoffmeisteri	6	1	
Quistradrilus multisetosus	4	3	
Tubificidae	102	33	15
VENEROIDEA			
Sphaeriidae	6	4	9

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0703243], Station #10, Sample Date: 3/19/2007 4:30:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	CS	NF	RM	SG
"HYDRACARINA"				
Acarina		2	4	2
AMPHIPODA				
Hyalella azteca			5	1
Stygobromus	1			
ARHYNCHOBDELLIDA				
Erpobdellidae		-99		
COLEOPTERA				
Agabus			3	
Neoporus			7	
Stenelmis	23			
DIPTERA				
Ablabesmyia			1	
Aedes				1
Ceratopogoninae		38		
Chrysops	-99			
Cladopelma		1		
Cnephia	1			
Cricotopus/Orthocladius	276	4	169	81
Dicrotendipes		1	2	31
Diplocladius	1			
Diptera		2	1	
Eukiefferiella brevicalcar grp	42		6	22
Forcipomyiinae				9
Glyptotendipes	2			21
Hydrobaenus	220	57	66	151
Kiefferulus				1
Nanocladius			1	
Orthocladius (Euorthocladius)	8			3
Parachironomus			1	
Paraphaenocladius				2
Paratendipes	1			
Polypedilum illinoense grp			1	
Procladius		4		1
Pseudosmittia		1		2
Simulium	1			
Tanytarsus		1		
EPHEMEROPTERA				
Caenis latipennis	1	2	2	
HEMIPTERA				

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0703243], Station #10, Sample Date: 3/19/2007 4:30:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	CS	NF	RM	SG
Corixidae		2		1
ISOPODA				
Caecidotea (Blind & Unpigmented)	4		1	
Lirceus	1		3	
LIMNOPHILA				
Ancylidae		1		
Fossaria	1			2
Helisoma	1			
Menetus	1			
Physella	1		6	2
LUMBRICULIDA				
Lumbriculidae	1			
MESOGASTROPODA				
Hydrobiidae	2		2	
ODONATA				
Ischnura		1	2	
PLECOPTERA				
Allocapnia	7			
Perlesta	3			
TRICHOPTERA				
Rhyacophila	-99			
TUBIFICIDA				
Aulodrilus		4		
Branchiura sowerbyi	1	25		2
Enchytraeidae	14	12	5	6
Ilyodrilus templetoni		44		1
Limnodrilus cervix	1	4		
Limnodrilus claparedianus		5		
Limnodrilus hoffmeisteri	3	15	1	
Tubificidae	75	99	1	5
VENEROIDEA				
Sphaeriidae	13	19	5	3

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0703244], Station #1, Sample Date: 3/20/2007 10:00:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	CS	NF	RM	SG
"HYDRACARINA"				
Acarina	1	4	10	2
AMPHIPODA				
Hyalella azteca	8		55	12
ARHYNCHOBDELLIDA				
Erpobdellidae	2	-99		
COLEOPTERA				
Berosus	6			2
Dubiraphia	3	5	26	1
Hydroporus		2	6	1
Peltodytes			1	
Scirtidae				1
Stenelmis sexlineata	23			
DECAPODA				
Orconectes virilis			-99	
DIPTERA				
Ablabesmyia		8	1	1
Ceratopogoninae	7	9	7	3
Chrysops	-99			
Cladopelma		4		
Clinotanypus			4	
Corynoneura			2	2
Cricotopus/Orthocladius	95	25	34	46
Cryptochironomus	1	1		
Dicrotendipes	7	6	5	35
Diptera			1	3
Eukiefferiella brevicalcar grp	12			
Glyptotendipes	8	2	5	80
Hydrobaenus	15	10	22	38
Kiefferulus				1
Limonia				2
Microtendipes	2			
Parakiefferiella			1	1
Paraphaenocladius		5	3	2
Paratanytarsus			1	1
Paratendipes	57	1		
Polypedilum convictum	73		2	
Polypedilum illinoense grp	9	7	29	17
Polypedilum scalaenum grp	107	3		
Procladius		58	9	3

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0703244], Station #1, Sample Date: 3/20/2007 10:00:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	CS	NF	RM	SG
Pseudosmittia			1	1
Simulium	3			
Smittia				1
Stenochironomus	2			1
Stictochironomus	1			
Tanypus		2		
Tanytarsus	52	22	7	14
Thienemanniella	1			
Thienemannimyia grp.	2		1	1
Tribelos				1
EPHEMEROPTERA				
Acerpenna	1			
Caenis latipennis	27	11	5	7
Hexagenia limbata	-99	1		
Stenacron			1	1
Stenonema femoratum	-99			
HEMIPTERA				
Corixidae		2	1	1
ISOPODA				
Lirceus			2	
LIMNOPHILA				
Fossaria		3	6	
Helisoma	3		-99	
Laevapex	4	1		
Menetus	4		1	
Physella	3		2	
Planorbella	1			
LUMBRICULIDA				
Lumbriculidae	1			
MESOGASTROPODA				
Hydrobiidae	6	2	10	7
ODONATA				
Argia			2	
Enallagma			5	1
Ischnura			-99	
Pachydiplax longipennis			-99	
PLECOPTERA				
Hydroperla crosbyi	-99			
RHYNCHOBDELLIDA				
Glossiphoniidae	-99	-99	-99	

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0703244], Station #1, Sample Date: 3/20/2007 10:00:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	CS	NF	RM	SG
TRICHOPTERA				
Agrypnia		-99		
Oecetis	2	1	5	
Rhyacophila	-99			
TUBIFICIDA				
Aulodrilus	1	1	1	
Enchytraeidae	1	4		8
Ilyodrilus templetoni	4	12	2	1
Limnodrilus cervix		1	3	
Limnodrilus hoffmeisteri	1	2	13	
Quistradrilus multisetosus	4	41	3	1
Tubificidae	35	12	33	
VENEROIDEA				
Corbicula	2			
Sphaeriidae	2	3	2	1

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0703245], Station #5, Sample Date: 3/20/2007 1:00:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina	1	7	1
AMPHIPODA			
Hyalella azteca	2	28	7
ARHYNCHOBDELLIDA			
Erpobdellidae	1	-99	1
COLEOPTERA			
Berosus			1
DECAPODA			
Orconectes virilis		-99	
Procambarus acutus	-99		
DIPTERA			
Ablabesmyia	1		
Ceratopogoninae	25	9	
Chaoborus	2		
Chironomus	1		
Chrysops		1	
Cladopelma	1		
Clinotanypus	5	1	2
Cricotopus/Orthocladius	11	10	9
Dicrotendipes	19	20	48
Diptera	1		1
Einfeldia	4		
Eukiefferiella			2
Forcipomyiinae			1
Glyptotendipes	33	15	190
Hydrobaenus	15	6	2
Kiefferulus	1	1	3
Nanocladius	4	9	1
Paraphaenocladius		2	1
Polypedilum halterale grp	11	2	1
Polypedilum illinoense grp	5	17	4
Polypedilum scalaenum grp	1	2	1
Procladius	98	11	10
Pseudosmittia		1	
Simulium	1		
Tanypus	2		
Tanytarsus	1	2	
Thienemannimyia grp.		2	
Tipula		-99	

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0703245], Station #5, Sample Date: 3/20/2007 1:00:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
EPHEMEROPTERA			
Caenis latipennis	14	21	5
Leptophlebiidae		-99	
HEMIPTERA			
Corixidae	1		
Ranatra nigra		-99	
ISOPODA			
Lirceus		44	-99
LEPIDOPTERA			
Noctuidae	2		
LIMNOPHILA			
Ancylidae	1		1
Fossaria		8	1
Helisoma	-99	-99	
Menetus		1	
Physella	2	9	1
LUMBRICINA			
Lumbricina	3		
MEGALOPTERA			
Chauliodes rastricornis		-99	
Sialis	-99		
MESOGASTROPODA			
Hydrobiidae		1	2
ODONATA			
Argia	1		
Enallagma		2	
Ischnura		4	
Nasiaeschna pentacantha		-99	
Pachydiplax longipennis		-99	
Plathemis	-99	1	
RHYNCHOBDELLIDA			
Glossiphoniidae	-99	3	
TRICHOPTERA			
Limnephilidae		-99	
Oecetis	1		
Ptilostomis			1
TRICLADIDA			
Planariidae	4	84	2
TUBIFICIDA			
Aulodrilus	8		3

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0703245], Station #5, Sample Date: 3/20/2007 1:00:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Branchiura sowerbyi	6		-99
Enchytraeidae	2	1	1
Ilyodrilus templetoni	29	1	1
Limnodrilus cervix	3		
Limnodrilus hoffmeisteri	3	8	
Quistradrilus multisetosus	3		
Tubificidae	49	13	
VENEROIDEA			
Sphaeriidae	9	2	1

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0703246], Station #6, Sample Date: 3/20/2007 3:30:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	CS	NF	RM	SG
"HYDRACARINA"				
Acarina		5	4	
AMPHIPODA				
Hyalella azteca	1	1	47	
ARHYNCHOBDELLIDA				
Erpobdellidae	-99	-99		
COLEOPTERA				
Dubiraphia		5	2	
Scirtidae			4	
Stenelmis	19			
DECAPODA				
Orconectes virilis			-99	
Procambarus acutus		-99	1	
DIPTERA				
Ablabesmyia		1	5	4
Ceratopogoninae	6	57	4	1
Chaoborus		1		1
Cladopelma		9		
Cladotanytarsus	1	1		
Cricotopus/Orthocladius	235	12	111	164
Cryptochironomus	4	1		
Cryptotendipes		5		
Dicrotendipes	7	11	7	21
Diptera		2		1
Eukiefferiella	41	2	1	15
Glyptotendipes	2	1	1	2
Hydrobaenus	58	43	20	31
Nanocladius		1	2	
Ormosia	1			
Orthocladius (Euorthocladius)	1			
Parakiefferiella	2		7	
Paraphaenocladius		2	1	
Paratanytarsus				2
Paratendipes	26	4		
Polypedilum convictum	1			
Polypedilum halterale grp		8		1
Polypedilum illinoense grp	1		17	8
Polypedilum scalaenum grp	3			
Procladius		45	2	8
Rheocricotopus	1			

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0703246], Station #6, Sample Date: 3/20/2007 3:30:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	CS	NF	RM	SG
Simuliidae	18		1	4
Smittia		1	1	2
Tanytarsus	11	2	1	3
Tipula		-99		
Tribelos		1	1	1
Zavreliella		1		
EPHEMEROPTERA				
Caenis latipennis	17	41	40	14
Leptophlebia			1	
Stenacron			-99	1
Stenonema femoratum	1		3	-99
HEMIPTERA				
Corixidae		1		
ISOPODA				
Lirceus	1	4	36	2
LIMNOPHILA				
Ancylidae	1			
Fossaria	1	1		1
Helisoma				1
Menetus		1		
Physella			9	4
Planorbella	1			
LUMBRICULIDA				
Lumbriculidae	23	3	1	3
MEGALOPTERA				
Sialis		-99	-99	
MESOGASTROPODA				
Hydrobiidae			2	2
ODONATA				
Dromogomphus		-99	-99	
Enallagma			1	
Ischnura			-99	
Libellula		-99	-99	
Nasiaeschna pentacantha			1	
PLECOPTERA				
Perlesta	3			
RHYNCHOBDELLIDA				
Glossiphoniidae		-99		
TRICHOPTERA				
Oecetis		1		

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0703246], Station #6, Sample Date: 3/20/2007 3:30:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	CS	NF	RM	SG
Rhyacophila	2		-99	
TUBIFICIDA				
Branchiura sowerbyi	5	7	2	
Enchytraeidae	3	1		1
Limnodrilus claparedianus	2			
Limnodrilus hoffmeisteri	17	2		
Quistradrilus multisetosus			1	
Tubificidae	93	12	3	5
VENEROIDEA				
Sphaeriidae	10	5	2	1

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0703247], Station #9a, Sample Date: 4/3/2007 3:00:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	CS	NF	RM	SG
"HYDRACARINA"				
Acarina	1	22	3	1
ARHYNCHOBDELLIDA				
Erpobdellidae	1	-99	-99	
COLEOPTERA				
Ancyronyx variegatus			1	
Dubiraphia		2	1	
Gyrinus			3	
Hydroporus		6	6	
Stenelmis sexlineata	44	1		
DECAPODA				
Orconectes virilis			-99	
DIPTERA				
Ceratopogoninae		17		3
Chironomus		2	1	1
Cricotopus/Orthocladius	82	5	86	153
Cryptochironomus	2			
Dicrotendipes	1	3	12	36
Diplocladius			1	
Diptera		5	1	
Dolichopodidae			1	
Eukiefferiella brevicalcar grp	74	2	18	61
Forcipomyiinae		1		4
Glyptotendipes			10	5
Hydrobaenus	212	121	47	42
Labrundinia			2	
Mesosmittia			1	
Micropsectra			2	
Nanocladius			2	
Parachironomus			3	
Parakiefferiella	1		1	
Parametriocnemus	3			
Paratendipes	15			
Polypedilum halterale grp		2		
Polypedilum scalaenum grp	4			
Procladius		1		
Simulium	63	3	14	5
Smittia		1		
Tanytarsus	2	1	4	2
Thienemanniella	1		1	

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0703247], Station #9a, Sample Date: 4/3/2007 3:00:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	CS	NF	RM	SG
EPHEMEROPTERA				
Caenis latipennis	4	8	3	1
Callibaetis		1		
ISOPODA				
Lirceus			8	
LIMNOPHILA				
Helisoma			1	
Menetus		1	5	
Physella	2	11	37	1
LUMBRICULIDA				
Lumbriculidae	1		1	
MESOGASTROPODA				
Hydrobiidae	1		2	5
ODONATA				
Enallagma			6	1
Epicordulia			-99	
Gomphus			-99	
Libellula			1	
Macromia		1		
Plathemis			-99	
PLECOPTERA				
Isoperla			1	
RHYNCHOBDELLIDA				
Glossiphoniidae		-99	-99	
TRICHOPTERA				
Uenoidae			-99	
TRICLADIDA				
Planariidae			13	
TUBIFICIDA				
Branchiura sowerbyi	2	23		
Enchytraeidae	4	1	2	1
Ilyodrilus templetoni		4		
Limnodrilus hoffmeisteri	21	5	2	
Tubificidae	108	70	4	
VENEROIDEA				
Sphaeriidae	9	5	6	

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0703248], Station #9b, Sample Date: 4/3/2007 3:00:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	CS	NF	RM	SG
"HYDRACARINA"				
Acarina		8	1	1
ARHYNCHOBDELLIDA				
Erpobdellidae	1		-99	
COLEOPTERA				
Helichus basalis			1	
Hydroporus		3	9	
Peltodytes				1
Stenelmis	65		1	
DIPTERA				
Ablabesmyia		3	1	
Ceratopogoninae	1	17	2	1
Cricotopus/Orthocladius	53	9	63	137
Cryptochironomus	1	1		
Dicrotendipes	3	2	1	11
Diptera	1	1	2	
Eukiefferiella	63	1	14	49
Forcipomyiinae				2
Glyptotendipes	1	1	2	3
Hydrobaenus	136	131	58	61
Labrundinia		1		
Nanocladius			3	
Parachironomus			1	
Parametriocnemus	1			
Paratendipes	20	2		
Polypedilum		2		
Polypedilum halterale grp		2	1	
Psychodidae		1		
Simulium	58		26	3
Stictochironomus		1		
Tanytarsus	1		5	4
Thienemanniella				2
Thienemannimyia grp.	2	2	1	
Tribelos				1
EPHEMEROPTERA				
Caenis latipennis	6	7	2	2
HEMIPTERA				
Corixidae		4		
ISOPODA				
Lirceus	2		15	

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0703248], Station #9b, Sample Date: 4/3/2007 3:00:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	CS	NF	RM	SG
LIMNOPHILA				
Ancylidae	1	2		
Fossaria	1			2
Helisoma	1		4	-99
Physella		17	58	12
MESOGASTROPODA				
Hydrobiidae	6	2	3	
NEUROPTERA				
Climacia				1
ODONATA				
Argia			1	
Enallagma			2	
Epicordulia			-99	
Gomphus		1		
PLECOPTERA				
Perlesta	9		2	
TRICHOPTERA				
Ceraclea			2	
TRICLADIDA				
Planariidae			3	
TUBIFICIDA				
Branchiura sowerbyi	4	15		1
Limnodrilus hoffmeisteri	28	4		
Tubificidae	152	106	17	1
UNIONIDA				
Unionidae			-99	
VENEROIDEA				
Sphaeriidae	6	5	1	

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0703249], Station #8, Sample Date: 4/3/2007 5:45:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	CS	NF	RM	SG
"HYDRACARINA"				
Acarina		7		3
AMPHIPODA				
Gammarus			1	
ARHYNCHOBDELLIDA				
Erpobdellidae	-99	3		
COLEOPTERA				
Dubiraphia		1	1	
Neoporus		2	6	1
Stenelmis	22		2	
DECAPODA				
Orconectes virilis			-99	
DIPTERA				
Ceratopogoninae	9	18	2	7
Chaoborus		1		
Chironomus				1
Chrysops	-99			
Cladopelma		4		
Cricotopus/Orthocladius	13	1	30	60
Cryptochironomus	2	1		
Cryptotendipes				1
Dicrotendipes	1	3	2	7
Diplocladius	1			
Diptera		4		1
Dixella			1	
Eukiefferiella brevicalcar grp	68		12	14
Glyptotendipes				2
Hydrobaenus	75	9	50	155
Kiefferulus		1		
Microchironomus		1		
Micropsectra			3	
Nanocladius			7	
Parakiefferiella			3	
Paratanytarsus			1	1
Paratendipes	108	1		
Polypedilum halterale grp	1	4		2
Polypedilum scalaenum grp	4			
Procladius		4		2
Simulium	27		11	
Stictochironomus				1

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0703249], Station #8, Sample Date: 4/3/2007 5:45:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	CS	NF	RM	SG
Tanypus		2		
Tanytarsus	2	2	2	4
Thienemanniella	1		1	
Tipula	-99		-99	1
Tribelos		1		
EPHEMEROPTERA				
Caenis latipennis	1	1	5	2
HEMIPTERA				
Corixidae		2		7
ISOPODA				
Lirceus			28	12
LIMNOPHILA				
Ancylidae	1	1		
Fossaria			1	1
Helisoma		1	-99	1
Physella	4	11	101	36
Planorbella	1			
LUMBRICULIDA				
Lumbriculidae	5	1		
MESOGASTROPODA				
Hydrobiidae		3	4	28
ODONATA				
Enallagma			5	
Libellula		-99		
Macromia			1	
Nasiaeschna pentacantha			1	
PLECOPTERA				
Perlesta	8			
TRICHOPTERA				
Oecetis			1	
TRICLADIDA				
Planariidae			1	
TUBIFICIDA				
Aulodrilus	1	1		1
Branchiura sowerbyi	2	23		
Enchytraeidae	17	7	4	3
Ilyodrilus templetoni		6		
Limnodrilus hoffmeisteri	16	14	1	
Tubificidae	234	145	3	4
VENEROIDEA				

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0703249], Station #8, Sample Date: 4/3/2007 5:45:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	CS	NF	RM	SG
Sphaeriidae	13	5	-99	3

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0703251], Station #7, Sample Date: 4/4/2007 1:30:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	CS	NF	RM	SG
"HYDRACARINA"				
Acarina			1	
AMPHIPODA				
Hyalella azteca			4	
ARHYNCHOBDELLIDA				
Erpobdellidae	4		1	
COLEOPTERA				
Hydroporus			2	
Scirtidae			1	
Stenelmis	93			
DIPTERA				
Ablabesmyia		1		
Anopheles			1	
Ceratopogoninae	2	7	5	2
Chironomus		15	1	
Cladotanytarsus		1		
Clinotanypus			1	
Cricotopus bicinctus		1	1	
Cricotopus/Orthocladius	52	28	16	152
Cryptochironomus		2		
Dicrotendipes		10	30	17
Diplocladius	1			
Diptera		21		4
Eukiefferiella brevicalcar grp	88	8	1	94
Glyptotendipes	3	6	4	
Hydrobaenus	41	43	25	21
Limnophyes				1
Micropsectra	1	1	3	
Nanocladius		1	10	
Ormosia				2
Parachironomus		1	1	
Parakiefferiella			1	
Parametriocnemus	2			
Paratendipes	2	2		
Polypedilum illinoense grp			2	
Pseudochironomus			2	
Simulium	188	1		67
Stictochironomus	2	8		
Tanytarsus		1	2	2
Thienemanniella	1			

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0703251], Station #7, Sample Date: 4/4/2007 1:30:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	CS	NF	RM	SG
Zavreliella		1		
EPHEMEROPTERA				
Caenis latipennis	7	22	38	1
Heptageniidae	1			
HEMIPTERA				
Ranatra nigra			-99	
ISOPODA				
Lirceus	1	6	30	
LIMNOPHILA				
Ancylidae		2		
Fossaria		1	-99	
Helisoma	-99		-99	
Physella		7	101	6
Planorbella			1	
Planorbidae			1	
LUMBRICULIDA				
Lumbriculidae	2	5		
MESOGASTROPODA				
Hydrobiidae	24	1	2	2
NEUROPTERA				
Climacia	1			
ODONATA				
Argia			1	
Enallagma			16	
Epicordulia		-99	1	
Nasiaeschna pentacantha			-99	
PLECOPTERA				
Perlesta	19			
RHYNCHOBDELLIDA				
Glossiphoniidae			-99	
TRICHOPTERA				
Ceraclea			1	
Oecetis			-99	1
TRICLADIDA				
Planariidae		1	2	
TUBIFICIDA				
Branchiura sowerbyi	2	4		
Enchytraeidae		2		
Limnodrilus hoffmeisteri	10	4		
Quistradrilus multisetosus		1		

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0703251], Station #7, Sample Date: 4/4/2007 1:30:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	CS	NF	RM	SG
Tubificidae	177	86	1	1
VENEROIDEA				
Sphaeriidae	3	1	1	-99

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0703252], Station #3, Sample Date: 4/4/2007 3:15:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina	4	2	
AMPHIPODA			
Hyalella azteca	2	84	
COLEOPTERA			
Hydroporus	1	1	
DECAPODA			
Orconectes virilis		-99	
Procambarus acutus	-99		
DIPTERA			
Ceratopogoninae	12	9	
Chaoborus	2		
Chironomus	4	2	
Chrysops		1	
Cladopelma	2		
Clinotanypus	1		
Cricotopus bicinctus			2
Cricotopus/Orthocladius	2	90	202
Dicrotendipes	5	5	2
Diptera	10		
Empididae	2		
Endochironomus	1	1	
Eukiefferiella brevicalcar grp			14
Glyptotendipes	1	2	
Hydrobaenus	3	5	16
Labrundinia		1	
Ormosia	1		
Pilaria		-99	
Polypedilum illinoense grp		1	
Procladius	7	1	
Simulium	1	17	24
Tanytarsus	7	2	1
Thienemanniella			1
Thienemannimyia grp.		1	
Tribelos			2
EPHEMEROPTERA			
Caenis latipennis	14	49	2
Heptageniidae	1		
Hexagenia limbata	5	-99	
Stenacron	1	1	

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0703252], Station #3, Sample Date: 4/4/2007 3:15:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
HEMIPTERA			
Corixidae	2		1
ISOPODA			
Lirceus	6	66	7
LIMNOPHILA			
Helisoma			-99
Lymnaeidae	1		
Menetus	1		
Physella	10	2	15
Planorbella			2
LUMBRICULIDA			
Lumbriculidae	2		
MESOGASTROPODA			
Hydrobiidae			1
ODONATA			
Argia			-99
Basiaeschna janata		-99	
Ischnura		4	
Libellula			-99
Nasiaeschna pentacantha		1	
TRICHOPTERA			
Ironoquia		1	
Oecetis	1	2	
TUBIFICIDA			
Aulodrilus	2		
Branchiura sowerbyi	1		
Enchytraeidae	30	7	1
Ilyodrilus templetoni	7	3	
Limnodrilus cervix	4		
Limnodrilus claparedianus	1		
Limnodrilus hoffmeisteri	29	5	
Quistradrilus multisetosus	12		
Tubificidae	94	4	
VENEROIDEA			
Sphaeriidae	3		

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0703253], Station #2, Sample Date: 4/5/2007 10:30:00 AM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina	10	1	1
AMPHIPODA			
Hyalella azteca		81	4
ARHYNCHOBDELLIDA			
Erpobdellidae	-99		
COLEOPTERA			
Berosus		1	
Dubiraphia	1		
Dytiscidae	1		
Hydroporus	2	2	
Peltodytes	1	1	1
Stenelmis	1		
DECAPODA			
Orconectes virilis	-99	-99	
DIPTERA			
Ablabesmyia	1	6	
Anopheles		1	
Ceratopogonidae	22	1	2
Chironomus	20		3
Cricotopus/Orthocladius	12	15	80
Cryptochironomus	1		
Cryptotendipes	4		
Dicrotendipes	3	4	12
Diptera	6		2
Eukiefferiella	1		11
Forcipomyiinae			5
Glyptotendipes		2	3
Hydrobaenus	52	6	141
Micropsectra			1
Nanocladius	8	4	1
Parachironomus		1	
Paratanytarsus		1	
Polypedilum halterale grp	6		
Procladius	9		
Simulium	3	9	
Tabanus		1	
Tanytarsus	6	4	6
Thienemanniella	7	4	2
Thienemannimyia grp.	6	1	1

Aquid Invertebrate Database Bench Sheet Report
North Fk Spring R [0703253], Station #2, Sample Date: 4/5/2007 10:30:00 AM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Tribelos		1	1
Zavreliella	4		
EPHEMEROPTERA			
Caenis latipennis	33	32	4
Stenacron		1	
HEMIPTERA			
Corixidae	4	1	7
Neoplea		4	
Trichocorixa		-99	
ISOPODA			
Lirceus	17	121	45
LEPIDOPTERA			
Cossidae	-99		
LIMNOPHILA			
Fossaria	1		
Menetus		2	
Physella	14	66	28
Planorbella			3
Planorbidae	1		1
ODONATA			
Enallagma	1	3	
Ischnura		1	
Nasiaeschna pentacantha		-99	
Pachydiplax longipennis		-99	
PLECOPTERA			
Perlesta			2
TRICHOPTERA			
Cheumatopsyche		-99	
Oecetis	1	1	
TRICLADIDA			
Planariidae		3	
TUBIFICIDA			
Limnodrilus claparedianus	1		
Limnodrilus hoffmeisteri	1	5	
Quistradrilus multisetosus	12	3	
Tubificidae	94	31	18
VENEROIDEA			
Sphaeriidae	3		

Aquid Invertebrate Database Bench Sheet Report
Little Drywood Ck [0703250], Station #1, Sample Date: 4/4/2007 11:00:00 AM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina		1	1
AMPHIPODA			
Crangonyx		23	
Hyalella azteca	1	13	
ARHYNCHOBDELLIDA			
Erpobdellidae	-99		
COLEOPTERA			
Dubiraphia	1	1	
Haliplus		1	
Neoporus	22	19	
DECAPODA			
Orconectes		1	
Palaemonetes kadiakensis	6	9	
DIPTERA			
Ablabesmyia		1	
Ceratopogoninae	19	3	2
Chrysops	1		
Clinotanypus	1		
Cricotopus/Orthocladius	11	9	83
Dicrotendipes	1		10
Diptera	7	8	1
Eukiefferiella			20
Glyptotendipes			20
Hydrobaenus	2	1	14
Kiefferulus			2
Larsia		6	
Parakiefferiella		2	
Paratendipes			1
Polypedilum scalaenum grp			6
Procladius	8	12	
Pseudosmittia		1	
Simulium			4
Tanytarsus	2	5	1
Thienemanniella			2
Thienemannimyia grp.			1
Tipulidae	2		
Tribelos			4
EPHEMEROPTERA			
Acentrella			3

Aquid Invertebrate Database Bench Sheet Report
Little Drywood Ck [0703250], Station #1, Sample Date: 4/4/2007 11:00:00 AM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Caenis latipennis	20	10	1
Leptophlebiidae		1	
Stenacron			3
HEMIPTERA			
Corixidae	2		
Neoplea		1	
ISOPODA			
Lirceus	160	198	45
LIMNOPHILA			
Fossaria		4	3
Physella	9	82	37
Planorbella			3
MESOGASTROPODA			
Hydrobiidae	1	17	4
ODONATA			
Ischnura		1	
Macromia		1	
TRICHOPTERA			
Ironoquia	1	1	
Oecetis			1
TUBIFICIDA			
Aulodrilus	1		
Branchiura sowerbyi	2	2	1
Enchytraeidae	6	8	
Ilyodrilus templetoni	6	2	
Limnodrilus claparedianus	1		
Limnodrilus hoffmeisteri	9	12	
Tubificidae	73	14	3
VENEROIDEA			
Sphaeriidae	9		1

Aquid Invertebrate Database Bench Sheet Report
Horse Ck [0703241], Station #1, Sample Date: 3/19/2007 10:30:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina		3	8
AMPHIPODA			
Hyalella azteca		1	3
ARHYNCHOBDELLIDA			
Erpobdellidae	-99	1	
BRANCHIOBDELLIDA			
Branchiobdellida	5		
COLEOPTERA			
Berosus			7
Dineutus			-99
Dubiraphia	3	5	2
Helichus lithophilus	3		-99
Macronychus glabratus	4		
Neoporus		6	1
Stenelmis	13		
DECAPODA			
Orconectes luteus	-99		
Orconectes virilis	-99		
Palaemonetes kadiakensis			-99
DIPTERA			
Ablabesmyia		1	
Ceratopogoninae		11	7
Chaoborus		4	
Chironomus		1	
Chrysops		1	1
Cladopelma		10	2
Cricotopus/Orthocladius	55	4	80
Cryptochironomus		1	
Cryptotendipes			1
Dicrotendipes	2	6	2
Diptera		2	
Dolichopodidae		2	
Eukiefferiella brevicalcar grp	212	2	24
Glyptotendipes	1	5	1
Hexatoma	1		
Hydrobaenus	54	61	49
Kiefferulus	1	4	1
Labrundinia	1		
Limonia			-99

Aquid Invertebrate Database Bench Sheet Report
Horse Ck [0703241], Station #1, Sample Date: 3/19/2007 10:30:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Mesocricotopus	2	1	1
Natarsia			1
Nemotelus			1
Ormosia		1	
Orthocladius (Euorthocladius)	7		2
Parakiefferiella	2		3
Paraphaenocladius	25	33	14
Paratanytarsus			3
Paratendipes	1	1	
Pericoma		1	
Polypedilum illinoense grp		1	7
Procladius		52	13
Pseudosmittia		7	3
Simulium	97		1
Smittia		1	2
Stictochironomus		2	
Tabanus	-99		
Tanypus		2	
Tanytarsus	4	9	8
Tipula	-99		
Tribelos		2	
Tvetenia bavarica grp	8		
EPHEMEROPTERA			
Caenis latipennis	19	9	4
Leptophlebia			-99
ISOPODA			
Lirceus	11		16
LEPIDOPTERA			
Noctuidae			4
LIMNOPHILA			
Ancylidae	3	4	
Helisoma			-99
Menetus	1		
Physella	1		4
LUMBRICULIDA			
Lumbriculidae	14	1	1
MESOGASTROPODA			
Hydrobiidae	1	1	7
ODONATA			
Argia			1
Basiaeschna janata			-99

Aquid Invertebrate Database Bench Sheet Report
Horse Ck [0703241], Station #1, Sample Date: 3/19/2007 10:30:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Enallagma		1	
Libellulidae			1
PLECOPTERA			
Isoperla	3		
Paracapnia angulata	1		
Perlesta	37		2
TRICHOPTERA			
Ironoquia			1
Nectopsyche		1	
Rhyacophila	5		1
TUBIFICIDA			
Aulodrilus		2	
Branchiura sowerbyi	1	2	
Enchytraeidae	34	26	6
Ilyodrilus templetoni		2	
Limnodrilus cervix		5	
Limnodrilus claparedianus		2	
Limnodrilus hoffmeisteri	1	11	4
Quistradrilus multisetosus	1		1
Tubificidae	43	116	11
VENEROIDEA			
Sphaeriidae	21	1	

Aquid Invertebrate Database Bench Sheet Report
Cedar Ck [0703242], Station #1, Sample Date: 3/19/2007 2:30:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina		1	18
AMPHIPODA			
Hyalella azteca			57
ARHYNCHOBDELLIDA			
Erpobdellidae	-99	1	
COLEOPTERA			
Dineutus			1
Neoporus		8	60
Peltodytes			6
Scirtidae			18
Stenelmis	11		
DIPTERA			
Ceratopogoninae	3	32	1
Chironomus	1	2	
Cladopelma		11	
Cnephia	1		
Cricotopus/Orthocladius	202	2	26
Cryptochironomus		1	
Diamesa	1		
Einfeldia		4	
Eukiefferiella brevicalcar grp	79		1
Glyptotendipes	3		10
Hydrobaenus	195	22	15
Kiefferulus		4	2
Orthocladius (Euorthocladius)	11		
Paraphaenocladius		1	
Polypedilum illinoense grp			1
Procladius	1	69	1
Pseudosmittia	6	2	
Simulium	5		
Smittia		1	
Tabanus			1
Tanypus		23	
Tanytarsus	1	5	3
EPHEMEROPTERA			
Acentrella	2		
Caenis latipennis			3
Fallceon		1	
Leptophlebiidae	1		

Aquid Invertebrate Database Bench Sheet Report
Cedar Ck [0703242], Station #1, Sample Date: 3/19/2007 2:30:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
HEMIPTERA			
Ranatra fusca			2
Ranatra nigra			1
ISOPODA			
Lirceus	-99		6
LIMNOPHILA			
Ancylidae	1		1
Helisoma			1
Menetus		1	2
Physella	1	1	19
LUMBRICINA			
Lumbricina	-99		
LUMBRICULIDA			
Lumbriculidae		1	
MEGALOPTERA			
Sialis		1	
ODONATA			
Epicordulia		-99	
Nasiaeschna pentacantha			1
Somatochlora		-99	
PLECOPTERA			
Allocapnia	4		
Hydroperla	1		
Isoperla	57		
TRICHOPTERA			
Hydroptila	1		
TRICLADIDA			
Planariidae			2
TUBIFICIDA			
Aulodrilus		13	
Branchiura sowerbyi		3	
Enchytraeidae	11	2	3
Limnodrilus hoffmeisteri		2	3
Quistradrilus multisetosus		28	5
Tubificidae	19	60	21
VENEROIDEA			
Sphaeriidae		8	4